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DAILY EDITION

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WE GUARANTEE, that of this issue more than 9,200 copies were printed; that of those more than 9,200 copies, 7,048 were mailed to regular paid subscribers; 200 were provided for counter and news companies' sales; and 1,700 were printed for distribution at Atlantic City and for use as sample copies.

FOR breadth of understanding and clear, concise expression of the duties of the American Railway Master Mechanics' Association, it would be difficult to obtain a better exposition than in the address of President Crawford. In some respects, it is generally felt that the association has not done all that should be fairly expected of it. That it has accomplished much cannot be denied, but that it should accomplish more is equally true. Mr. Crawford points out a few of the more important subjects that have heretofore been neglected and should now be taken up in an energetic manner. The confusion possible in connection with the selection of a train resistance formula from the thirty-three or more now equally authoritative is indicated and it is suggested that this association should be the one to clear it up by adopting an official formula after a careful investigation. There would seem to be no body of railroad men better suited for this duty. A proper method of determining the capacity of a locomotive in connection with its ability to haul trains is badly needed. This association should also provide that.

IT is the practice of the Master Boiler Makers' Association to ask one or two representative railroad or government officials to address it at each session. At its convention, held last month in Chicago, addresses were made by W. L. Park, vice-president, Illinois Central; C. A. Seley, formerly chief mechanical engineer, Rock Island Lines; Robert Quayle, superintendent of motive power, Chicago & North Western and J. F. De Voy, assistant superintendent of motive power,

Chicago, Milwaukee & St. Paul, as well as John F. Ensign, chief inspector, and Frank McNamany, assistant chief inspector, Interstate Commerce Commission, department of locomotive boiler inspection. It was a rather noteworthy fact that each of these speakers took occasion to commend the boiler inspection law and to express satisfaction with its enforcement. It seems that this result is due to a fully digested law, prepared with the advice of practical men, and a spirit of fairness exhibited by both the railroads and the federal inspectors. The enforcement of the law has caused considerable trouble and expense to the railroads at times, but in no case has an appeal been taken from the inspector's ruling, and the good results that have been gained are well shown by Mr. Ensign's annual report. A sharp distinction was drawn by some of the speakers between the boiler inspection law and some State laws, the full crew and head-light laws being mentioned in particular.

IT is no longer a question as to whether or no the mechanical stoker will work, but rather as to how efficiently it will work. We have gone beyond the stage when an experimental device is expected to run without attention or repair, or be condemned, and have taken the stoker to ourselves as a part of the locomotive's mechanism that must be closely looked after and be carefully inspected if it is expected that it will do its work. For a number of years the stoker has been regarded as an excessive consumer of coal; at least, that it showed no economy in fuel consumption. Much of this waste was attributed, and probably rightly, to the ease with which the fireman could put coal into the firebox, but now it seems that the men using the stoker have learned its ways and are saving the coal as they used to save their muscles, and the stoker is showing a saving of fuel consumption as compared with hand firing. Not that there is much, if any, saving on a test between the stoker and hand firing when a first-class man is used for the hand work, and he is on his mettle to do his best, but that when the average performance of the first-class man is compared with that of the average performance of the stoker, the latter is coming out a little ahead. That two diverse types of stokers have been developed to their present stage of efficiency speaks well for the future possibilities, and it looks now as though in the very near future the stoker would be taken as much as a matter of course as a part of a locomotive's construction as the safety valve or the injector, whose development through this same stage of possibility, probability, desirability and necessity some of us can most distinctly remember.

AS was indicated by one of those who discussed the report on mechanical stokers, the fact that the thoughts of most of the speakers took the direction of the possible fuel economies showed conclusively that all doubt is now removed as to the practicability and success of stokers in regular service. The committee's report gave evidence of the same conclusion, so far as the two most prominent designs are concerned. The number now in service and the size of the orders given by individual railroads is further proof of confidence in their satisfactory operation in pooled service. The committee states that a saving in fuel can be expected not only in quantity but in the grade it is possible to use with the stoker. The discussion, however, gave little encouragement for a reduction in the quantity when compared with good hand firing. Various reports of comparative fuel consumption on a large number of locomotives in regular service covering a considerable period seem to indicate but little difference in the quantity consumed when coal suitable for hand firing is used in both cases. In regard to quality, however, there is every reason to expect a material saving, particularly with the scatter type of stoker. Lower grades of coal, not at all suitable for hand firing, are being successfully burned in many instances. In some cases the coal is screened and the lumps

are used for hand-fired locomotives and the slack for the stokers. On the basis of coal burned per ton-mile an hour, the stoker using a grade of fuel costing but half as much as run of mine should show a very handsome saving in cost. It was clearly stated by President Crawford that what should be expected from the stoker is more tons to the train. The problem is not so much how much coal is actually consumed as it is how many tons the locomotive can be made to pull. On some new locomotives now being finished, which in other respects are standard, the diameter of the cylinders has been increased by 2 in. in order to take full advantage of the power the stoker permits the boiler to deliver. Older engines are having the cylinders bored out to increase the diameter by 1 in. for the same reason. The stoker is but a part of the locomotive, and the best locomotive is the one that hauls the most ton-miles an hour. The stoker should be considered mainly from this standpoint. If the maximum work is performed at a lower fuel consumption per unit of traffic handled, it is most satisfying. But if not, the stoker can by no means be considered as failing to meet the real demand.

CO-OPERATE WITH OTHER ASSOCIATIONS.

WITH the possible exception of the Traveling Engineers' Association, the International Railway Fuel Association is, in some respects, the most valuable contemporary of the Master Mechanics' Association among the minor associations in the mechanical field. The work it performs is closely associated with, and ably supplements the activities of, the larger body, and it seems unfortunate that there is not more real co-operation between the two.

At its convention held in Chicago last month, the Fuel Association discussed the features of locomotive design that permit the successful burning of lignite, and it intends next year to discuss the design of front ends, grates and ash pans in general. In past years the Master Mechanics' Association has spent a great deal of time and considerable money investigating these particular features and has produced results of decided value. In view of the many subjects demanding attention, some of which are of considerably greater importance, it is quite proper that this and some other similar subjects should be left to the smaller and more highly specialized associations.

It would seem much better, however, to have the work continued rather than to have it undertaken anew. This could be accomplished by having a representative of the Master Mechanics' Association appointed on the committee of the Fuel or other association that is to take up the work. There is little doubt that such a request from the superior body would be accepted in the same spirit in which it was made. The duties of such a member should be advisory rather than active, and he should report to, and be under the control of his own executive committee. He could make a condensed report of how the subject was presented and the conclusions reached at the following convention. This could profitably be given a short time for discussion, and the members would obtain the benefit of a wider range of work without in any way restricting their energy along lines which they alone are suited to investigate. In fact, if the idea was followed to a logical conclusion, a number of subjects now carried on the list could be transferred and more time given to the broader and more important phases of the motive power official's work which are demanding more and more attention every day. Problems of organization, management, engineering and education are not receiving the attention they deserve from the Master Mechanics' Association, nor will they so long as so much attention is given to subjects which can be practically as well handled by some of the minor associations if the matter were put up to them officially and under the guidance of a representative member on each committee.

While the Fuel Association is taken as an example because it happens that it intends to consider several subjects which

have in the past been reported on by committees of the Master Mechanics' Association, the same relations are held by other similar specialized associations. Detailed subjects in connection with locomotive operation might well be referred to the Traveling Engineers' Association; matters pertaining to shop practice to the General Foremen's Association; air brake problems to the Air Brake Association, etc. The regular committee on subjects would be the judge as to which body was best suited to investigate and report.

This is one suggestion as to how closer cooperation between these, at present, practically detached bodies could be accomplished. President Crawford in his address on Wednesday morning suggested another scheme which eliminated any suggestion of influence by the Master Mechanics' Association. The manner of doing it, while important, is subordinate to the fact that something of the kind should be undertaken.

OBJECTIONABLE PUBLIC REGULATION.

NO part of President Crawford's address met with more hearty approval than his forcible references to the great amount of ill-considered and arbitrary railway legislation that still continues to be passed. Formerly such legislation related mainly to rates. Now it relates mainly to physical operation. The mechanical officers recently have felt the effects of much of it. Numerous safety appliance laws, boiler inspection laws, headlight laws and so on have been passed by Congress and the legislature; and in most cases without investigation and knowledge of the conditions to which they were to be applied, or decent consideration of the probable results.

It is not regulation of railway mechanical matters, or any feature of railway operation, that is objectionable. What is objectionable is regulation that disregards experience, flouts expert knowledge and counsel, arbitrarily applies sweeping and uniform provisions to widely diverse conditions, and heavily increases railway expenses without conferring any compensating public benefit. Most of the regulation of operation thus far has been of this character.

One remedy is for railway officers to make more frequent appearances, and present more vigorous opposition, before legislative committees. This they have begun to do through the Special Committee on Relation of Railway Operation to Legislation and its technical sub-committees and state committees. Another step is to get the handling of all such matters transferred from the legislatures to the various regulating commissions. Many of the commissions are imperfect enough; but they are more apt to make intelligent investigations and listen to reason, and less apt to be swayed by political influences, than members of the legislatures.

Most desirable of all is that Congress, by general legislation, shall concentrate in the Interstate Commerce Commission authority to regulate all phases of operation that are properly subject to public regulation at all. Many just criticisms may be made on the past work of the Interstate Commission. But, whatever its shortcomings, the Commission as at present constituted is at once the ablest in personnel, the most expert and the fairest body that ever regulated railways in this country. Within very recent years it has had to handle two important problems directly affecting the mechanical department, those relating to safety appliances, and locomotive boiler inspection. The railways were represented in the negotiations with it by some of their ablest mechanical officers, and, on the whole, the commission's attitude was fair and the policies it adopted not injurious but beneficial.

Regulation by commission has its very bad features; in fact, any sort of government regulation has; but probably it is only through increased regulation of operation by the Interstate Commerce Commission that the railways can escape from the ignorant, arbitrary, nagging and costly requirements that are being so rapidly multiplied by state legislatures and commissions.

TO-DAY'S PROGRAM.**M. M. ASSOCIATION.**

The following subjects which were on the program for Wednesday could not be considered on that day because of the extended discussion of the report of the committee on mechanical stokers:

Discussion of reports on:

Specifications for Cast-steel Locomotive Frames.

Individual papers on:

Maintenance of Electrical Equipment, by C. H. Quereau.

Engine Testing Plant, Prof. E. C. Schmidt.

The following is the scheduled program for to-day, which will probably follow the discussion of the above-mentioned subjects:

Discussion of reports on:

Main and Side Rods.

Safety Appliances.

Design, Construction and Maintenance of Locomotive Boilers.

Steel Tires.

Minimum Requirements for Headlights.

Standardization of Tinware.

Superheater Locomotives.

Specifications for Materials Used in Locomotive Construction.

Individual paper:

Three-cylinder Locomotives, by Mr. J. Snowden Bell.

Subjects.

ENTERTAINMENT.

Orchestra Concert, 10.30 A. M.—Entrance Hall, Million Dollar Pier.

Orchestra Concert, 3.30 P. M.—Entrance Hall, Million Dollar Pier.

Informal Dance, 9.30 P. M.—Entrance Hall, Million Dollar Pier.

REGISTRATION THIS YEAR.

The enrollment committee, C. B. Yardley, Jr., chairman, has adopted a new system which will very greatly extend the time during which members of the Master Mechanics' and Master Car Builders' Associations may register. The committee has been divided into three shifts, each composed of four members and assigned to duty during certain specified hours of each



Railway Supply Manufacturers' Association Badge.



M. M. Association Badge.



M. C. B. Association Badge.



Badge for Special Guests.

day. These shifts are so arranged that the work is distributed equally among them and a much more systematic and efficient operation of the enrollment work is expected than has been obtained in the past. Members of the committee have been notified that the following rules have been adopted and will be strictly enforced.

M. M., M. C. B. or Special Guest badges shall not be given to anyone but the rightful owner; no member of the Railway

Supply Manufacturers' Association will be permitted to take one for delivery except upon written order from the owner and the receiver must then sign for the badge.

No badge shall be issued to a member of the M. C. B. Association except on the payment of a fee of one dollar; M. M. and Special Guest badges will be issued, free of charge, to those entitled to them until 12 o'clock noon, Saturday, June 14, at which time M. M. badges will be withdrawn and a charge of one dollar made for all Special Guest badges. However, a member of the M. M. Association taking out a Special Guest badge and paying the required fee will be given his M. M. badge free and members of the M. M. Association who are also members of the M. C. B. Association can obtain their M. M. badge by paying for the M. C. B. badge.

A change has been made in the M. M. and M. C. B. badges this year; the celluloid disk has been entirely done away with and the year is included on the enameled disk, directly under the initials of the association; a rectangular piece of metal at the bottom of the disk forms a part of the badge and includes the registration number, as indicated in the accompanying illustration.

SAN FRANCISCO SEEKING THE 1915 CONVENTIONS.

A. M. Mortensen, traffic manager of the Panama Pacific International exposition, formerly with the Southern Pacific Company, is attending the convention in behalf of the great show to be held in San Francisco in 1915. The San Francisco people and the exposition management want the M. C. B. and M. M. conventions in 1915, and before leaving Atlantic City Mr. Mortensen will make an earnest plea and will cordially invite both the railway and railway supply men to journey to the coast in June of 1915.

TRANSPORTATION FOR RETURN RAILWAY TRIPS.

Through Secretary Taylor the Pennsylvania has notified the railroad members of the M. M. and M. C. B. associations wishing transportation home over the lines of the Pennsylvania Railroad or the Pennsylvania lines west of Pittsburgh, that such transportation will be provided, if they hand their names to Secretary Taylor. Owing to the requirements of the law, this transportation must be limited to bona fide railroad officials, and cannot include members from belt lines, car lines, or switching roads operated by industries.

City Ticket Agent Murphy, of the Pennsylvania Lines, Atlantic City, announces that return tickets can be secured and Pullman reservations made through his office, 1301 Pacific avenue.

COUPLER COMMITTEE EXHIBIT.

The coupler committee has an extensive and interesting exhibit just beyond the Convention Hall on the pier. In 1911 this committee was authorized to prepare a standard design of M. C. B. coupler. Since that time it has given considerable attention to studying the weak points of couplers on various roads throughout the country where the service is exceptionally severe, and has worked jointly with the coupler manufacturers in outlining the requirements and specifications for a standard design.

After developing these specifications the different coupler manufacturers were asked to submit designs to meet the requirements. Six companies have designed such couplers, and they are now on exhibition so that the members may examine them carefully and come to some conclusion as to the most desirable design. The companies are the Buckeye Steel Castings Company, American Steel Foundries, Gould Coupler Company, The McConway & Torley Company, National Malleable Castings Company and Monarch Steel Castings Company.

It is also proposed to change the contour in order to strengthen the coupler, and templates are on exhibition showing the changes which are recommended for consideration.

MANUFACTURERS' DINNER TO THE BRAZILIAN MINISTER OF FOREIGN AFFAIRS.

By special permission of the United States State Department, the American Manufacturers' Export Association will entertain His Excellency, Dr. Lauro Muller, minister of foreign affairs for Brazil, on the day of his arrival in New York, June 17. He will be given an automobile trip throughout the city, which will be followed by a luncheon at the Hotel Plaza.

This visit of the distinguished Brazilian statesman will be his first to the United States. Manufacturers of railway supplies will be interested in the entertainment given him by the manufacturers in New York, because some very prominent railway supply men will participate in it and because it will call attention, among other things, to the large and growing market in Brazil for American railway supplies.

It is expected that the entertainment accorded to Dr. Muller in New York will be dignified and in every way suitable to the importance of the occasion. Joseph E. Davis, the new commissioner of corporations of the United States, will be the principal speaker, and there will also be other distinguished speakers. The price of the luncheon per plate will be \$8 and reservation should be made immediately, owing to the limited time remaining. The committee in charge reserves the privilege of seating the guests as may seem most advisable.

Among the members of the reception committee are the following men, prominently connected with the railway supply industry: Waldo H. Marshall, president, American Locomotive Co.; C. M. Muchnic, manager foreign department, American Locomotive Co.; Alba B. Johnson, president, Baldwin Locomotive Works; William de Kraft, Baldwin Locomotive Works; A. N. Hargrave, J. G. Brill & Co.; E. J. Buckner, vice-president, E. I. Du Pont de Nemours Powder Co.; Charles Landis, E. I. Du Pont de Nemours Powder Co.; M. A. Oudin, manager foreign department, General Electric Co.; L. D. Albin, Ingersoll-Rand Co.; M. S. Baldwin, Otis Elevator Co.; H. L. Gemberling, Sherwin-Williams Co.; James A. Farrell, president, U. S. Steel Corporation; W. E. Leigh, Western Electric Co., and W. J. Marsden, Yale & Towne Manufacturing Co.



Information Bureau; 11 A. M. Wednesday.

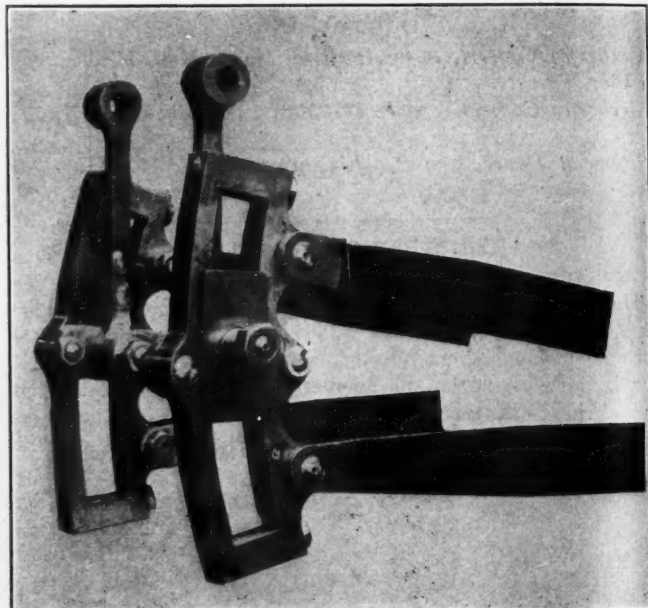
THE ORCHESTRA CONCERT ON THE PIER.

The orchestra concerts yesterday morning and afternoon at the entrance hall of the Million Dollar Pier proved very popular and were well attended. The hall was an attractive place for the ladies to wait while the men were registering.

DUPLICATE PARTS FOR LOCOMOTIVES.

An important feature of the work of any locomotive builder is the furnishing of duplicate or spare parts for locomotives in service. This is particularly true in the case of locomotives operating on short lines or in logging, contracting or other industrial service. In such cases the operating company frequently carries no stock of patterns, and has not the facilities for furnishing spare parts promptly.

It is evidently essential, in work of this kind, that like parts of similar locomotives be made interchangeable, and that duplicate parts be so made that they will be sure to fit the engine for which they are intended. The necessity for this was realized by M. W. Baldwin, founder of the Baldwin Locomotive Works, as early as 1839, and at that time he took steps toward introducing such a system of manufacture. It was not, however, until 1865, that the organization of a department of standard gages was finally completed. This department is in charge of an expert machinist, and it



Duplicate Eccentric Links Furnished Recently for a Locomotive Built in 1867.

maintains all original standard gages and templets, from which duplicates are made for use in the shop. The system insures interchangeability of like parts of locomotives built to the same design. The ordering of duplicate and spare parts at the Baldwin Locomotive Works is handled by the department of repairs, and the work is given preference in order to insure prompt completion. Whenever a locomotive changes hands, or has any modifications made in its design subsequent to its shipment from the works, a record of the fact is kept, if possible. This is an aid in insuring accuracy when furnishing duplicate parts.

The accompanying illustration shows a set of links, with their lifters and eccentric rods, recently supplied for a locomotive built in 1867, in use on the Ironton Railroad. A letter from S. R. Thomas, superintendent, states that the shipment was made exactly two weeks after the order was placed and that all parts fitted exactly. The locomotive to which these links were applied is of the mogul (2-6-0) type, with cylinders 16 in. x 22 in. and 44 in. diameter driving wheels.

MASTER MECHANICS' ASSOCIATION PROCEEDINGS.

Includes the Address of President Crawford and the Reports
on Mechanical Stokers and the Revision of the Rules.

The first session of the forty-sixth annual convention of the American Railway Master Mechanics' Association was held at Atlantic City, June 11, 1913. President D. F. Crawford called the meeting to order at 10 A. M. The past presidents of the American Railway Master Mechanics' Association, and the Master Car Builders' Association, and the members of the executive committees of the two Associations were invited to take seats at the front of the hall. The opening prayer was offered by the Rev. Newton W. Cadwell, pastor of the Olivet Presbyterian Church of Atlantic City.

PRESIDENT CRAWFORD'S ADDRESS.

It is with a deep personal appreciation of the privilege and with sincere pleasure that I welcome you to the forty-sixth annual convention of the American Railway Master Mechanics' Association. Today marks the beginning of the

There is present today, a gentleman whom we are proud to welcome, and who has been a member of this association since 1907. On account of his residence he might be looked on as a non-resident member. To be with us he has crossed the ocean, and by his presence indicates that it is no longer an estranging ocean, and I am sure you will all join me in offering friendly greetings to our fellow member. I refer to Henry Fowler, chief mechanical engineer of the Midland Railway of England.

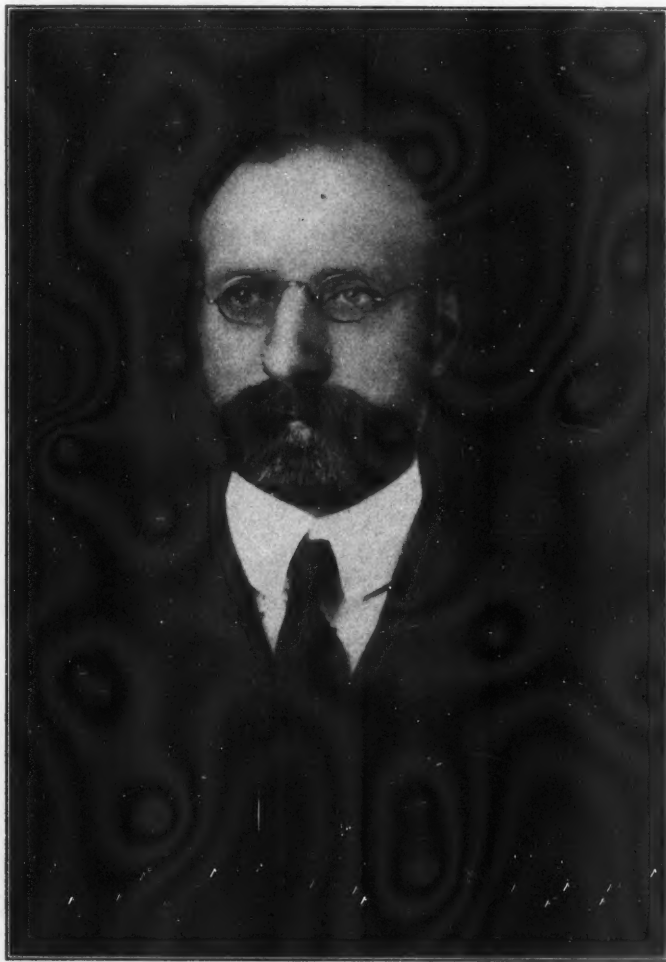
The Railway Supply Men's Association has again prepared for your inspection and instruction the splendid exhibit of railway appliances, which we all have become accustomed to regard as a useful part of our convention, and I am told that the number of exhibitors is greater, and the space occupied larger, than at any previous convention.

While these exhibits are of undoubted value to those



D. F. CRAWFORD,

President, M. M. Association, and Vice-President, M. C. B. Association.



T. RUMNEY,

First Vice-President, M. M. Association.

eighth consecutive convention of your Association held at Atlantic City, and I trust that it will prove as profitable, instructive and enjoyable as those which have preceded it.

Permit me to express my gratitude to you for giving me the opportunity of having my name added to that honor roll—the list of presidents of this important association, as well as for the opportunity to perform the pleasant duty of presiding at this convention. You may be sure that I have and will put forth my best efforts to maintain the dignity and effectiveness of our association, which had been so splendidly carried forward by my twenty-nine capable and distinguished predecessors.

The presence of the ladies is appreciated by all of us and I wish to extend to them, and to all of our guests, the most cordial welcome.

attending these conventions, the difficulty in obtaining sufficient space, and the expense incident to installation, lead me to suggest that the most careful consideration be given by those in authority in the Supply Men's Association, to the question of the wisdom of their further extension.

After most careful consideration of the subject at a joint meeting with the executive committees of the Master Car Builders' Association and the Railway Supply Men's Association, it was decided that the entertainment features of this convention be carried out along the same lines as determined upon for the conventions of last year; namely, that the participants bear their prorata share of the expenses, and that the entertainment be less formal in character than was the practice previous to the 1912 meeting.

In order that the fullest possible opportunity be given for the inspection of the splendid exhibits it was decided to omit from the program, the usual ball game; thus permitting

the members and guests to devote the entire day of Saturday to the exhibits, or to those informal meetings, which are so conducive to better acquaintance, and consequently to the interchange of information, which is difficult to accomplish in the regular sessions. It is sincerely hoped that the entertainment provided will be found agreeable and that every one present will do their utmost to make this meeting pleasant as well as profitable for one another.

There will be no report this year from a committee on consolidation. After several years' consideration of this subject it was apparent that the majority of the members of the association were opposed to the suggestion. While it is true that after forty-five years of good service it hardly seems wise that the American Railway Master Mechanics' Association should lose its identity, I am compelled to say that a closer working arrangement with the Master Car Builders' Association is desirable, and it is thought that the suggestion made by President Bentley in 1912; namely, that the two associations meet in one week, with a joint session on one day, would probably bring about the desired results, without the consolidation of the two associations.

It seems imperative, however, that the Master Mechanics'

struction, maintenance and operation of railway equipment. J. Ramsey McDonald says, "Legislation must work with life, not try to tyrannize over it, and life is such a confusing welter of interdependent relationships that legislation very often dislodges an evil from one place only to give it abode in another."

The above is particularly applicable to that legislation which tends to produce rules and regulations which are in conflict with well-known physical and mechanical laws, and impose burdens from which proper returns in safety, reliability and economy cannot be obtained. It is important that this association, and its members, co-operate with the Federal, State and other authorities to bring about a better understanding of the limitations in the construction and operation of railway equipment, so that such future legislation as may be desirable will be in accord with the principles of physics and mechanics, rather than tending away from them as is now too often the case.

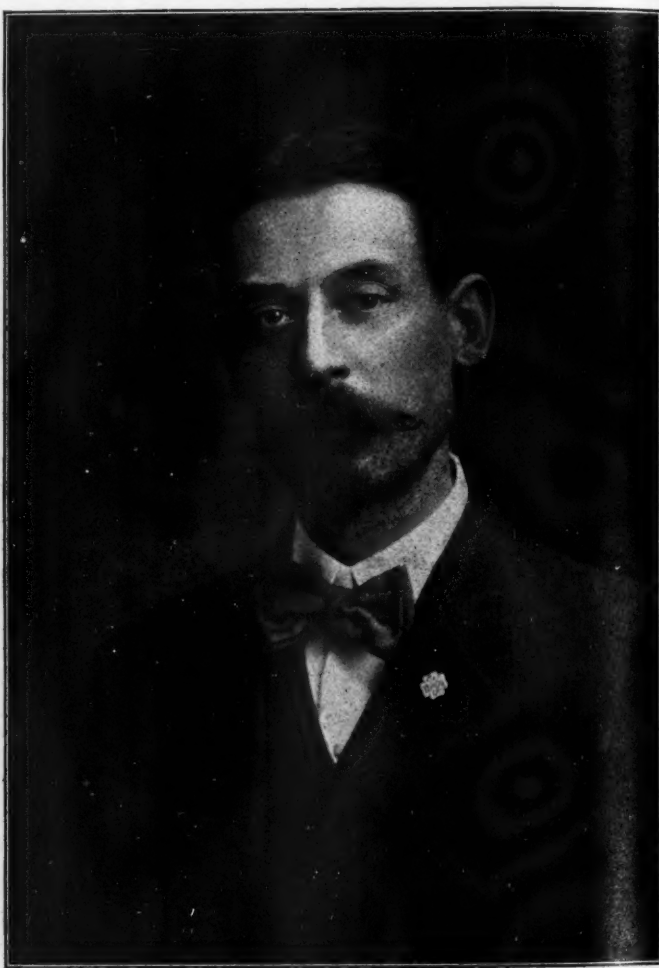
Bills have been introduced in the Federal Congress and in several states requiring that locomotives be equipped with headlights of high candle power. I have witnessed several tests of headlights of various intensities, under operating



D. R. MacBAIN,
Second Vice-President, M. M. Association, and Vice-President,
M. C. B. Association.

Association take cognizance of what is being done in the line of work which comes under the supervision of the members of this association, by the General Foremen's Association, Air Brake Association, Fuel Association, and the Society for Testing Materials, and to assist, as far as possible, in making the work of these industrious and capable associations of greater value to the railways and to the public. To this end I suggest that either the Committee on Subjects, or a special committee, review the work done by these associations so that the information obtained may be given to this association, perhaps in the form of an individual paper by a member of the associations named.

Legislative action, both Federal and State, continues to occupy the minds of the railway men of the country, and many of the measures under consideration involve the con-



F. F. GAINES,
Third Vice-President, M. M. Association.

conditions, and cannot refrain from congratulating the association upon its action in the convention of 1912, when you passed the resolution opposing the use of high power headlights on railways with multiple tracks, and with interlocking or automatic signals. My observations lead me to fear that extending the use of high power headlights will result in more frequent accidents, and consequently, loss of life and damage to property; the danger increasing in relative proportion to the density of traffic, the number of tracks and signals.

Since the convention of 1912 the engineers and firemen's requests for wage increases, and changed working conditions have been settled by arbitration; the former by a Board of seven, with the Honorable Oscar Strauss and Doctor Chas. Van Hise, as chairmen, and the latter by a board of three, as provided for in the Erdman Act, with the Honorable William L. Chambers, as chairman. The proceedings of both of these

hearings contain much data and information which is of interest and value to the members of this association, and no doubt have been reviewed by all of the members.

During the hearings of the firemen's case frequent reference was made to the proceedings of this association. This should bring home to us the need that the association obtain and promulgate such comprehensive and accurate data on all questions regarding the locomotive and its operation, that its proceedings will be looked upon as the most reliable and authoritative information available on the construction, maintenance and operation of locomotives. It should also provide record of the comparative results obtained with different types of locomotives in different service, under the many varying conditions. The desirability of such authoritative information, representing the consensus of opinion, and bearing the approval of a recognized organization, will be apparent to all who are familiar with the proceedings of the arbitration cases above mentioned.

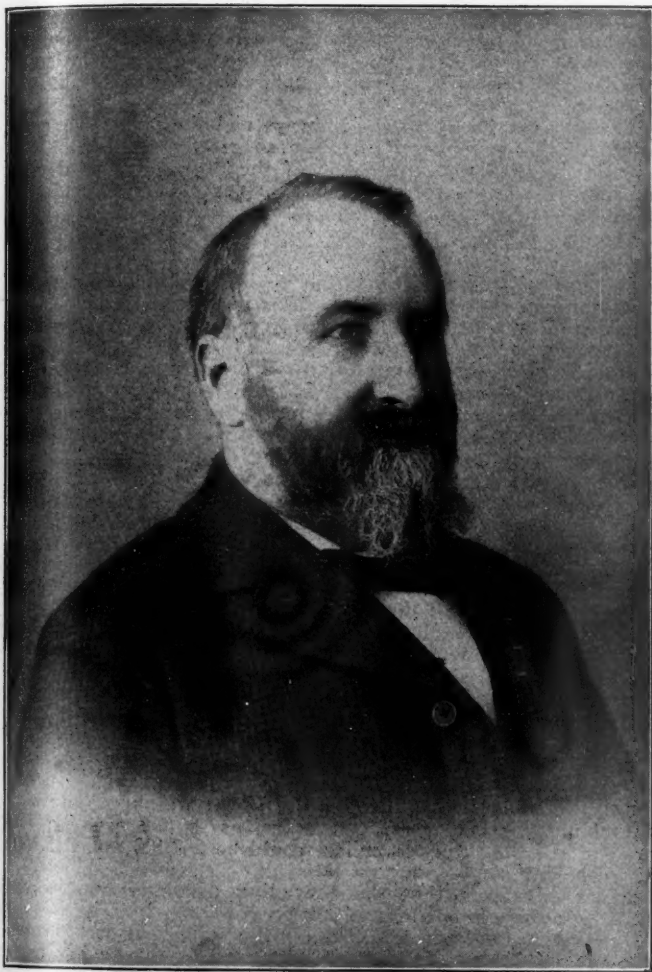
A number of books and articles have been published recently on Railway Operating Costs; among these the wide-

efforts of manufacturers of supplies, rather than the members of the associations."

Also this: "It seems as if the subjects now up for discussion before the various association of railway officials are inconsequential when compared with the more important problems that have been overlooked."

The writer of the above was evidently not aware that very wisely, by common consent in this association, and by prohibition of the by-laws of the Master Car Builders' Association, the very complex problems of labor cannot be discussed. As to the suggestion regarding labor, however, I will offer one thought. The increasing demand for labor in this country will cause to continue the influx of emigrants. Indeed we can look forward to the time when much of the skilled and semi-skilled labor, and all of the unskilled labor, will be of foreign origin.

The majority of these men are, or have the capability of becoming good workmen, but both the employers and employees suffer on account of misunderstandings arising from dissimilar languages. While the situation may be improved



ANGUS SINCLAIR,
Treasurer, M. M. Association.



J. W. TAYLOR,
Secretary, M. M. Association and M. C. B. Association.

ly distributed book prepared by Messrs. Suffren & Son, from which I quote:

"The members of the Maintenance of Way Association, of the Master Mechanics' and of the Master Car Builders' Associations are in direct control of sixty per cent. of the operating expenses of the railroads they represent, yet the proceedings of their meetings contain no mention of the labor problem. Their entire attention is directed toward the subject of materials—"

"An enormously effective and valuable work could be done through the medium of these associations in the standardizing of equipment. There is no reason why, given reasonable time, a movement for the standardization of equipment could not be carried to its logical conclusion, but for some inscrutable reason the attention of the members has been directed only toward unit designs for small parts. In some instances at least this standardization of parts has been due to the

by the employment of interpreters there still remains grounds for suspicion. Therefore to meet the condition which will become more and more difficult, it would seem wise to encourage the younger supervising officers of the railways to become proficient in one of the foreign languages; preferably Italian. With this accomplishment that confidence between employer and employee, which is so necessary to success, may be established.

From my experience with the work of the association I cannot but agree with the writer mentioned, that entirely too much attention is devoted to material and consideration of the locomotive as a mechanical device, rather than as an instrument of transportation. The study of the general proportions, the hauling capacity, the adaptability of machine to specific work, obtaining the maximum output with minimum expense is of far more importance to the railways, and to the public, than the study of the smaller details of the

machine and the minute variations in the composition of the materials used in its construction.

As to the standardization of equipment, much has already been accomplished; true, largely in the details of construction, but each detail decided upon holds out promise of more readily reaching an agreement on the larger problems.

The reports of the several committees which will be presented during the sessions, you may be sure, represent the results of careful study of the questions, and I am sure they will receive the most thorough and complete discussion, so that there will be added to the records of the association, information of value to all who may have occasion to consult them.

I will not refer to the reports in detail, but desire to call your attention to some points regarding the work of several of the existing committees.

The committee on Smoke Prevention has before it what is perhaps one of the more important questions under consideration by the railways. The public and the authorities of almost every city, and of many towns and villages, are insisting on the reduction of smoke from locomotives, and in some instances legislation, not only requiring the reduction of smoke, but compelling its elimination by substitution of electric power for the steam power is contemplated. It is particularly desirable, therefore, at this time, that this subject receive the greatest possible consideration, and that its discussion will bring out all the available information on the subject.

I also beg to suggest that in view of the importance of this subject that this committee be continued as a standing committee, and authorized to confer and co-operate with the many other associations, technical and civic, engaged in the study of the question. In Chicago, Pittsburgh and many other cities, commissions, each with a large staff of engineers, chemists, physicians, etc., are employed in obtaining information and endeavoring to solve the problem, and the experience of our members should be of value in this work.

It is also recommended that the committee on Specifications for material be made a standing committee. The Society for Testing Materials has given this subject the most careful attention, but it would seem that the requirements of material for a particular purpose could better be determined by the practical experience of the consumer than by the more or less theoretical consideration of comparative results obtained under test conditions. This committee should, of course, confer and co-operate freely with the committees of other associations, and give them a full measure of the results obtained in practice, so that they can be coupled up with the laboratory observations; thus permitting the promulgation of specifications which will not only cover suitable material, but which will insure uniformity in quality by prescribing adequate and decisive laboratory tests.

The Committee on Minimum Requirements for Locomotive Headlights, after full consideration of the subject, has undertaken a comprehensive series of tests, as well as the compilation of existing information on the subject.

When it was suggested that a committee to report on super-heater locomotives be appointed, I remember that it was stated that this subject had been fully covered in previous reports. So far from this being the case reference to the proceedings of the Firemen's Arbitration will show that more definite information is necessary, and furnish ample reason for reopening this important question.

As future work for the association I wish to suggest the re-opening of three subjects, which have not only been considered by it, but by others. However, when one consults the existing literature, the lack of sufficiently definite information, and the conflict of such as is given, is apparent.

Undoubtedly the members of this Association and the railways would appreciate and find useful more exact and authoritative advice on these subjects:

TRAIN RESISTANCE.

In 1900 the *Engineering News* published a chart on which there was plotted twenty-one separate formulas for determining train resistance. These formulas gave the seeker of information the choice of resistances at a speed of five miles per hour, or from 2.1 pounds per ton to eight pounds per ton, and at a speed of sixty miles per hour, or from six pounds per ton to twenty-nine pounds per ton. In 1903 the number of formulas had increased to thirty-three, with the same limitations at five miles per hour, but at sixty miles per hour the range had extended to thirty-one and six-tenths pounds per ton. At speeds between five miles and sixty miles per hour the thirty-three formulas gave every opportunity to exercise a wide individuality in the selection of a resistance.

During the ten years elapsing from the time of thirty-three formulas to date, many more have been developed, but these, rather than assisting, have rendered it more difficult to make

a selection. Indeed, a short time ago, in applying one of the most generally accepted and frequently used formulas to actual dynamometer measurement, the drawbar pull determined by the formulas was somewhat over twice the amount shown by the dynamometer as actually used to move the train at the running speed.

There is much data available, and a committee of this association could obtain much more which would enable it to offer to all interested a method and formula which would be sufficiently accurate to be of practical application and value. Why not establish the American Railway Master Mechanic's Resistance Formula?

LOCOMOTIVE LOADING, OR TONNAGE RATING.

At present the railways are giving this subject a great deal of attention, but are using different methods. In the past fifteen years much information has been obtained on this subject, and recently quite a number of highly interesting and instructive articles have appeared on the subject in the technical press.

There is no more important work that this association can perform than to take from the mass of available data, supplemented by such additional records of investigations as may be necessary, and promulgate a thoroughly practical, and at the same time, an accurate method of determining the hauling capacity of locomotives, and train loading that would be suitable for all kinds of locomotives under the varying conditions of service.

Would it not insure to the railways and the public the possibility of that economical operation so greatly desired, and at the same time add to the honor of the association, to devise and approve a method of operation so logical that there could be no question of its general adoption?

STATISTICS.

The use of this word, without giving the statistician his usual rank in comparison with other members of the "Ananias Club," is indeed difficult. I have been so greatly impressed by the use of statistical data by financiers, the Interstate Commerce Commission, Federal and Legislative committees, arbitration boards, and the technical press, that it seems only proper that those statistics which reflect the results of physical action and performance should at least bear some relation to the originating forces, and take cognizance of the potential available, as well as the results obtained.

The expense of owning, maintaining and operating a locomotive, or other power producing device, is much more a function of the potential available than it is of the burden carried. That is to say, the cost of owning and maintaining, and a large portion of the operating costs of a given locomotive is the same whether the load hauled is one car or fifty.

That the so-called tonnage mileage basis does not adequately meet the situation may be shown by a simple illustration: A given locomotive (with exactly the same interest, depreciation, maintenance, crew, fuel and operating costs, moving one class of cars, will produce on a certain division, 168,000 lading ton miles, while with another class of cars, the same potential, and with no difference in expense, 216,000 lading ton miles will be produced. If the weight of the car is included, or the gross ton miles, as is the practice on some roads, the total ton miles would be 262,500 and 285,600 respectively.

While it is true that the averaging of many conditions tends to reduce the effect of such variations, it is desirable that some more logical unit than the lading or gross ton mile be considered for making comparisons of owning and operating costs and performance of equipment.

It is certain that there has been and will be many occasions when statistics of this kind, worked up on a uniform basis for all of the railways, would be of service. A committee of this Association could perform a useful service by devising such forms of statistics as would meet the requirements of the railways and others interested in their operation.

Another subject which is always before us is that of fuel economy, both as a matter of saving of expense to the railways, and as a conservation of one of the great natural resources of the country. No more important subject could be given the most careful consideration of this association; perhaps of all, the most competent to deal with it.

Locomotive testing plants are now established at the Purdue University, University of Illinois and at the Altoona shops of the Pennsylvania Railroad. Such of the information obtained at these plants as may be, with propriety, made public, might well be reviewed by a committee of this Association, and, with suitable comments and conclusions, included in the proceedings.

To summarize, it is my idea that the proceedings of the

American Railway Master Mechanics' Association should be a compendium of the existing knowledge covering the entire subject of construction, maintenance and operation of railway locomotives; steam, electric, or any other from which may be devised. For truly we are of those that Mr. Kipling designates as "The Sons of Martha."

"It is their care in all ages to cushion and buffet the shock;
"It is their care that the gear engages; it is their care that the switches lock.

"It is their care that the wheels run truly;

"It is their care to embark and entrain, tally, transport, and deliver duly, the Sons of Mary by Land and Main."

Our association has a membership of 1,074, which is a decrease of eleven members during the past year. Since our last convention Oscar Antz, New York Central Lines; F. M. Gilbert, New York Air Brake Company; Wm. Gill, Iowa Central; W. B. Howe, New South Wales Railway, Australia; C. E. Gossett, Minneapolis & St. Louis; M. A. Malloy, Pennsylvania. J. H. Murphy, Cincinnati, New Orleans & Texas Pacific; J. J. Ryan, Southern Pacific, and A. Forsyth, Chicago, Burlington & Quincy, Active Members; Geo. Richards, Old Colony, now part of the New York, New Haven & Hartford; Amos Pilsbury, Maine Central; Henry Schlacks, Denver & Rio Grande, Honorary Members, and Reuben Wells, Louisville & Nashville, president of this association 1882-1884, have departed this life, and their loss is felt keenly by the members of the association and by their friends.

In conclusion I desire to express my thanks to the officers of the association for their cordial assistance; to the members of the committees, and to those contributing papers, for their efforts in making this convention successful.

On behalf of the association I most heartily thank the Reverend Newton W. Caldwell for his assistance in opening this convention with suitable ceremony; the exhibitors for their labors in producing for us the splendid display of interesting devices; the members of the Supply Men's Association for their untiring efforts in co-operating with us in entertaining the members and guests; the Officials of Atlantic City, who have always received us so kindly, for their courtesy; the Hotel Men's Association, for the ample provision they have made for our creature comforts; and the members of the press, who have done so much for us individually and collectively.

Permit me to express the wish that we all may profit from the reports, papers and discussions, and that the information obtained will be of service to the railways that we represent, and also that we will all enjoy our visit to this beautiful city.

ASSOCIATION BUSINESS.

Secretary Taylor presented his report which showed the present membership of the Association to be: Active, 1,009; Associate, 21, and Honorary, 44, making a total of 1,074. The report of the treasurer, Angus Sinclair, showed a balance for the year 1912, derived from interest on various bonds, of \$1,369.32.

The report of the secretary and treasurer was referred to an auditing committee made up of C. H. Rae (L. & N.); E. W. Pratt (C. & N. W.), and J. F. DeVoy (C. M. & St. P.).

Secretary Taylor:—In November, 1891, the Stevens Institute received from this Association \$8,000 for the endowment of four scholarships. Under the arrangements made we were privileged to have four students at the Institute each year, free of the regular tuitions. The records show that we have averaged three and one-third per year. The Institute authorities advise that the income from this fund is not only insufficient to support these scholarships, but that something like \$2,000 has accumulated against this account. This matter was considered by the Executive Committee, a committee consisting of Dr. Angus Sinclair, G. W. Wudin, and Wm. Schlafge has been appointed to confer with the Institute authorities to see what steps could be taken to perpetuate these scholarships.

The dues for the ensuing year were fixed at \$5, per vote as before.

The following communication was read by Secretary Taylor:

The Executive Committee feels that the provisions of the constitution regarding honorary membership are not such as they should be; that an honorary membership in this association means what it says—an honor, a vote of appreciation for long and faithful service. It believes that the limit of five years for active or associate membership does not add anything to such honor. It believes there should be four forms of membership, namely, active, associate, life and honorary. The provisions regarding active and associate membership should remain as at present.

The Executive Committee would, therefore, give notice of the

following proposed change in article III, Section 5, to read:

"Members of the Association, active or associate, who have been in good standing not less than ten years, and who, through age or other cause, cease to be actively engaged in the mechanical department of railway service, may, upon unanimous vote of the members present at the annual meeting, be elected life members. The nominations must be made by the Executive Committee. The dues of the life members shall be remitted and they shall have all the privileges of active members, except that of voting.

"Members of the Association, active or associate, who have been in good standing, may, upon the unanimous vote of the members present at the annual meeting, be elected honorary members."

W. C. Hayes (Erie) as a member of the Traveling Engineers was granted the privilege of the floor.

MECHANICAL STOKERS.

Persistent energy in the perfection of the stoker is being rewarded, but it must be conceded that few, if any, devices applicable to the locomotive, having for their purpose the accomplishment of equal efficiency, have carried the difficulties surrounding the successful performance of the stoker, not so much on account of the operation to be performed, but the absence of choice as to arrangement, the absolute limitations in space, and conditions under which the machine must operate.

Within the past few years marked advancement has been made and there is no longer any question but that the stoker is of practical value and a perfectly feasible proposition.

More recent history very strongly points to the inevitable



A. KEARNEY,

Chairman, Committee on Mechanical Stokers.

conclusion that the success of the stoker is not exclusively of mechanical interest, but an operating question as well, and much has been due to the continued solicitude from the viewpoint of capacity, relative consumption, efficiency and operation.

In all the work and experimentation with the various schemes suggested, two distinct methods or principles for stoking a locomotive still characterize the stage of development. In one the coal is delivered to the firebox over the bed of the fire, not unlike hand-firing, which is generally termed the "scatter" system; while the other delivers the coal up through the bed of the fire from underneath and is designated as the "underfeed" stoker. Both methods have their advocates and strong points of defense. Consequently, having before us the results both types have accomplished, it would be unsafe to conjecture which school will ultimately survive. Probably both will continue to advance, but time only can foretell their fate, and which will in the end prove more economical.

The committee is therefore unprepared to even venture an opinion as to which type of stoker is better, as both have their points of advantage. There seems to have been a larger number of designs of stokers attempted which have had the "scatter" system for their basic principle than those endeavoring to develop the "underfeed" machine, and probably because the inventors have hoped to reproduce hand-firing conditions. Many more types have been worked out than now seem to occupy the field, but those that have lived are constructed upon either the one or the other principle, although they may have differed

materially in detail from those that now remain on the market, or have possibly reached the commercial stage of development.

Time seems to have resulted in eliminating many stoker designs, reducing the number mainly to the most prominent, namely, the Crawford, typifying the underfeed; and the Street, representing the "scatter" type. There are, however, two other stokers undergoing development, namely, the Gee and the Hanna, both of the scatter design; and possibly there are many other prospective designs or types which have not yet been presented to the railroads.

The stokers which have undergone some development, and may for that matter still be considered (as it is possible their designers are giving them further study with a view of further improvement, etc.), are the Strouse, Barnum, Hayden, Brewster, Harvey, Dickinson, Erie, Hanna, Gee, Crawford and Street.

The stoker situation, as well as the committee has been able to ascertain, is as follows:

STROUSE STOKER.

Seventy-six Strouse stokers have been built to date and applied to engines on 16 different roads, but on April 1, 1913, none were still in service, so far as known. This design of stoker interferes with the operation of the fire door when it becomes necessary to resort to hand-firing. It is one where all of the coal must be shoveled from the tank into a hopper.

BARNUM STOKER.

Seven Barnum or C. B. & Q. stokers have been built to date by the Burlington; 1 being applied to a switch engine, 1 to a prairie type road engine, and 5 to Santa Fe decapod engines. All of the latter stokers, we are advised, have been taken out of service on account of difficulties experienced in connection

CRAWFORD STOKER.

There have been 153 locomotives on the Penna. Lines West equipped with the Crawford double underfeed stoker. There are 140 locomotives on order which will be equipped with the Crawford stoker. The report is that it is probable that larger power built in future will be equipped with this type of stoker. The Vandalia reports 4 Crawford stokers in operation, and the Pennsylvania also has 2 in service, making a total of 159 Crawford stokers in service and 140 on order, or a grand total of 299 stokers.

STREET STOKER.

In May, 1909, a locomotive on the L. S. & M. S. was equipped with the first experimental stoker of the Street design. In 1910 5 more stokers were put in service, 3 of which were placed on the L. S. & M. S., where the first experimental stoker was operated. In the year 1911 7 locomotives on four different railways were equipped. All of the last 7, with but one exception, were provided with coal crushers carried on the tank, and handled run-of-mine coal. All of the machines, we are told, are still in regular service.

In the year 1912 165 machines of the screw-conveyor type were placed in service—70 on one railroad, 50 on another, 40 on another, and 5 on another. Since January, 1913, 7 additional machines were put in service, besides orders were placed for 50 more by one of the above roads, and an additional order was placed for 120 by another road. Thus we find that there have been 189 Street stokers applied to locomotives in service and 173 on order, making a grand total of 362.

It is particularly interesting to note that the Crawford and Street stokers, while representing two distinct types, are developing at about an equal rate, judging from the number of

TABLE I—RAILROADS REPORTING HAVING STOKERS IN OPERATION, TYPES OF STOKERS AND ENGINES TO WHICH THEY WERE APPLIED.

RAILROAD.	STOKER.		PRINCIPAL DIMENSIONS OF ENGINES TO WHICH APPLIED.								EXPECT TO APPLY	
	Number.	Type.	Type.	WEIGHT.		Steam Cylinders Inches.	Diam. Drivers Inches.	Heating Surface.	Grate Area.	Tractive Power.		
				Total.	On Drivers.							
Queen & Crescent.....	1	Hanna	Mallet.....								Re-designed Hanna.	
Carolina, Clinchfield & Ohio.....	1	Hanna	Mallet.....	342,650	209,250	23 35 x 32	57	5,607	78	70,640	One improved Hanna.	
New York Central & Hudson River.....	1	Street	Mallet.....									
Buffalo, Rochester & Pittsburgh.....	1	Street	2-8-2.....	275,000	217,000	26 1/2 x 30	63	3,625	56 4	51,160	Dependent on market for nut and slack coal.	
Vandalia R. R.....	4	Crawford	2-8-0.....	240,945	216,450	24 x 28	62	3,839	54 0	45,327	None	
Norfolk & Western.....	41	40	Street.....	2-6-8-2.....	405,000	337,300	22 35 x 32	56	5,006	72 2	73,000	50 Street and 1 Crawford
			Street.....	4-8-0.....	262,000	222,000	24 x 30	56	4,460	45 0	52,457	
			Street.....	4-8-2.....	331,000	241,100	29 x 28	62	4,129	66 7	68,100	
Chesapeake & Ohio.....	54		Street.....	2-8-2.....	315,000	243,000	29 x 28	56	4,052	66 7	60,800	No decision
			Street.....	2-6-8-2.....	400,000	337,500	22 35 x 32	56	5,041	72 2	82,000	
	50		Street.....	2-8-2.....	282,200	223,600	26 x 32	64	3,968	70	54,587	
Baltimore & Ohio R. R.....	13		Street.....	0-8-8-0.....	461,000	Fr. 232,700 Rear 228,300	26 41 x 32	56	5,578	100	105,000	To 127 engines.
	1		Street.....	2-8-0.....	220,370	198,650	22 x 30	60	2,876	57 05	42,168	
	98		Crawford.....	2-8-0.....	250,500	226,000	24 x 28	62	4,201	55 13	45,400	
	35		Crawford.....	4-6-2.....	293,250	189,525	24 x 26	80	5,098	55 4	32,600	
Pennsylvania R. R.....	165	18	Crawford.....	2-8-0.....	202,000	179,000	22 x 28	56	2,843	49 04	42,000	To probably large power built in future, 140 on order
	2		Crawford.....	0-6-0.....	135,000	135,000	19 x 26	51	1,755	31 54	28,200	
	2		Crawford.....	Not given.								
St. Louis & San Francisco R. R.....	1		Street.....	2-8-8-2.....	418,000	360,000	24 3/8 x 30	57	5,230	75	83,500	None

with the driving mechanism used with the taper screws in the stoker trough, also on account of the unsatisfactory distribution of fuel where the lower grades of coal were handled.

HAYDEN, HAYDEN MODIFIED, BREWSTER, HARVEY, DICKINSON AND ERIE STOKERS.

Nothing has been done during the past year with the above stokers. That is to say, none of them have passed from the experimental to the commercial stage. The experimental machines which were applied did not wholly meet the requirements of a stoker as viewed by the committee, in that several materially obstructed the fire door, which would interfere with hand-firing should such a course become necessary, and the others have not been sufficiently developed.

HANNA STOKER.

Eighteen or twenty stokers were applied to Mallet, consolidation and Pacific type locomotives on the Queen & Crescent, but it is our information they have all been taken out of service, in addition to the single stokers which were put on several different roads. The exception to the above is the one machine on the Carolina, Clinchfield & Ohio, which is still in service. The one on the latter road, we understand, continues to do good work, and the manufacturers promise to bring out another within a very short time possessing still further improvements.

GEE STOKER.

The Gee stoker is being developed on the Pennsylvania Railroad. Only one of this design has been built to date. It is in service on one of its H-6 consolidation locomotives, and is reported as giving very good results.

machines which have been applied. The Street stoker has been placed on a larger number of roads, while the Crawford stoker, with the exception of 2, has been confined to the Pennsylvania System. The 2 stokers referred to have been applied, 1 each, to two different railroads.

In Table I is shown a list of railroads which report using stokers, furnishing at the same time the number and type of each machine and the principal dimensions of the engines to which applied. An expression was invited concerning any further application of mechanical stokers, which was replied to as shown.

Checking the number of stokers reported as being in service, we find they include about 189 of the Street pattern. This figure was secured from the Locomotive Stoker company, and as but 165 are shown by the reports from the different roads, we conclude there are some roads using the stoker who have not replied to the circular.

The committee has been able to secure but little information concerning the actual and detailed operation of stokers from roads where they have been installed in any considerable number; however, the reports it has been able to secure have been put together, as shown, in tabulated form. While the information is quite limited, it will no doubt be of some interest.

Table II gives a comprehensive idea of the success with which the Crawford underfeed stokers have been operated on the Pennsylvania. The tabulation covers the performance of the stokers with respect to handling fuel. This information, while serving to show the operation of the stoker, unfortunately does not give the cost of maintenance and the character of its failures.

TABLE II.

PERFORMANCE OF THE CRAWFORD DOUBLE UNDERFEED STOKER ON THE PENNSYLVANIA LINES WEST OF PITTSBURGH, INCLUDING ALL TRIPS OF ALL STOKERS FROM THE EXPERIMENTAL INSTALLATION TO FEBRUARY 28, 1913.

Coal Fired by Stoker in Per Cent of Total Coal Fired.	Number of Trips.	Per Cent of Total Number of Trips.
100	19,475	61.0
99	280	0.9
98	416	1.3
95-98	1,530	4.8
90-95	1,847	5.8
85-90	680	2.1
80-85	903	2.8
75-80	1,209	3.8
70-75	379	1.2
Below 70	5,191	16.3
Total	31,910	100.0

Table III has been prepared to show the performance of the Street stoker on Mallet engines of the Norfolk & Western and Chesapeake & Ohio. The Norfolk & Western on the receipt of 40 Mallet locomotives, all equipped with the Street stoker, instituted a systematic record for stoker data, so as to show their complete performance, their failures and responsibility, and cost of repairs, separated for labor and material, both for the stoker as well as the brick arch with which the engines were also equipped. This table, as will be seen, also shows the total number of engine days, or days the engines have been in and out of service.

Talking the average performance of the Mallet engines on the Norfolk & Western up to February 1, 1913, it will be

value of the fuel used during the test, hence it is to be supposed that it was the same for the two tests.

General opinion seems to indicate that there is still some uncertainty as to any saving being accomplished in fuel. Some roads report that hand-firing, if properly executed, shows economy over stoker-firing, while there are just as many to report that the stoker has the advantage; then there are also others who regard it as a stand-off in coal consumption.

It is held by some who have been quite close to the work that under similar conditions there is some economy in fuel to be found with the stoker-fired engine, possibly 5 per cent., and this would seem quite logical, because it is conceded that the stoker burns a better fire, with the scatter type running from 4 to 6 inches in depth, as against 18 or 20 inches hand-fired. Furthermore, with the stoker the fire door is kept closed and the combustion must necessarily be more complete.

A saving in fuel, it would seem, can be expected, not only in quantity but in the grade it is possible to use with the stoker. Generally speaking, the best results seem to be obtained with the smaller sizes of fuel; in fact, with the scatter type machine, slack or crushed coal is necessary, and probably it can be used equally well with the underfeed machines, but the report is that the Crawford stoker has to date been giving good results with small lump coal. With improved combustion, coals lower in heat value (consequently cheaper in price) can be utilized, adding still further to economy conceded to the stoker.

It has also been observed that when starting out steam can be raised quickly, and probably with advantage as compared with hand-firing.

It seems to be admitted by even expert firemen who have had some years experience hand-firing, that they have derived valu-

TABLE III—PERFORMANCE OF MALLET ENGINES RELATING TO THE OPERATION OF STREET STOKERS, NORFOLK & WESTERN.

Month.	ENGINE DATA.			ENGINE FAILURES ATTRIBUTED TO STOKER.								Average Mileage per Stoker Failure.	Average Mileage per Failure Other Than Stoker.	STOKER REPAIRS INCLUDED IN REPAIRS TO STOKER ENGINES. (BRICK ARCH REPAIRS INCLUDED.)				BRICK ARCH REPAIRS INCLUDED IN REPAIRS TO STOKERS.			
	Total in Month.	Out of Service or in Shop of M. F. Department.	In Service or in Shop of C. T. Department.	Improper Handling.	Lack of Lubrication.	Hidden Defect.	Machinery or Fresh Break.	Shop Fail.	Clogged with Wood Bolts, Etc.	Total.	Labor in Dollars.			Material in Dollars.	Total in Dollars.	Accumulated Total Dollars.	Cost of Stoker and Brick Arch Repairs per 1,000 Miles.	Labor in Dollars.	Material in Dollars.	Total in Dollars.	Accumulated Total Dollars.
1912.																					
April...	52	12	40				2	1	1	8	4,835	No failures.	4,835	\$ 9.57	\$ 0.15	\$ 9.72	\$2.01				
May...	408	142	266	4						27,029	3,378.6	1,287	188.55	8.53	197.38	\$207.10	7.30				
June...	450	124	316							32,046	No failures.	2,670.5	178.88	21.80	200.68	407.18	6.26	\$ 3.60	\$19.82	\$23.42	
July...	465	117	343	1			1			34,624	8,656	5,770.6	149.17	30.41	179.58	587.36	5.18	.25	.28	\$23.95	
August...	405	116	389							37,309	No failures.	37,309	4,748.4	111.53	297.52	384.88	7.97	4.53	11.33	15.86	
Sept...	457	118	339							37,988	37,988	4,748.5	176.47	30.32	206.79	1,091.67	5.44	2.60	9.54	12.14	
Oct...	895	278	616	2	1			2	1	63,888.12	12,777.7	4,914.4	234.50	35.49	270.08	1,361.75	4.22	1.41	4.12	5.53	
Nov...	1199	372	827	4	1		1		1	84,983	12,140.4	5,065.5	403.62	72.21	475.83	1,837.58	5.60	3.44	.10	3.54	
Dec...	1240	429	811	2	1			2	2	89,698	11,212.2	2,718.1	415.06	73.63	488.69	2,326.27	5.45	3.22	6.43	9.65	
1913.																					
Jan...	1240	433	807	1	3	1	4		3	113,163	9,430.2	3,650.4	365.40	115.15	480.64	2,806.91	4.25	6.86	10.39	17.25	
Total.	6871	2152	4718	14	7	1	9	5	9	45	525,563			2,307.69	409.22	2,806.91		25.91	62.01	87.92	
Avg...	6871	215.25	471.85	1.4	0.7	0.1	0.9	0.5	0.9	4.5	52,556.3	11,679.2	3,527	230.77	40.92	280.69		5.34	2.59	6.20	

ON ENGINES OF THE CHESAPEAKE & OHIO RY.

1912.																					
Nov.										18	57,416	4,856				\$ 655.36		\$ 7.50			
Dec.										33	121,269	3,075				745.88	\$1,401.24	6.20			
Jan. 1913.										27	140,275	5,195				748.88	2,150.10	5.30			
Total.										78	348,960					2,150.10					
Avg.										26		4,474				716.70		6.16			

observed that the average number of failures per month was 4½, and the average mileage per stoker failure was 11,679 miles. The average mileage for failures other than those attributed to the stoker was 3,527 miles. The record shows 23.2 per cent. of the total failures were attributed to the stokers.

Another item of interest to which attention might be directed is the cost of stoker and brick arch repairs per 1,000 miles, which, as will be noted, averages \$5.34. The Chesapeake & Ohio furnish data showing the performance of 54 stoker-fired engines, covering a period of three months, namely, November and December, 1912, and January, 1913. The average mileage per stoker failure is found to be 4,474 miles, which is lower than the reports received from the Norfolk & Western. It will also be noted that the average cost for repairs per 1,000 miles is higher than indicated in the report from the Norfolk & Western, which might be a natural consequence, since the stoker failures were greater in number per miles service.

The committee sought to establish some data to show the relative fuel consumption in hand-firing as compared with the operation of the stoker, but there seems to have been very little reliable information so far obtained. The St. Louis & San Francisco has furnished a comparison of the coal consumption of the Mallet locomotive hand-fired versus stoker-fired, the runs being made over a district of 119 miles. The report shows that there were a number of delays occurring during the test runs which might to some extent affect the figures.

The information as presented indicates higher economy with hand-fired locomotives. They show an average evaporation of 9.13 pounds of water per pound of coal for four trips, while the stoker-fired engine gave an equivalent average evaporation of 7.88 pounds of water per pound of coal for five trips. No information is given bearing upon the quality, character or heat

able information in hand-firing after handling the stoker and closely watching its operation. With a more perfect combustion there is naturally some reduction in the emission of smoke, or unconsumed carbon, and it is also reported that where the stoker is properly handled it becomes necessary to use the fire hook but very little, if any, on the road, all of which should mean something in the direction of economy.

With reference to the character of coal used on stoker-fired locomotives, we find quite a variety of grades have been reported. In order to compare the different grades Table IV has been prepared, but comments seem quite unnecessary, as

TABLE IV.

Railroad.	Kind of Coal Used.	Per Cent of Ash.	Difference in Coal Used on Stoker-fired and Hand-fired Locomotives.
C. C. & O.	Bituminous, coking	7½ to 8.	Same coal used in each case.
Vandalia	Indiana semi-coking, Illinois coal of poor quality.	8 to 12.	Same coal when Indiana coal is used. No Illinois coal used on stoker-fired engine.
C. & O.	Run of mine and nut and slack coal, some coking and some non-coking	12 to 15.	Same coal used in crusher type stokers. Picked, special coal used in conveyor type.

TABLE IV.—Continued.

Railroad.	Kind of Coal Used.	Per Cent of Ash	Difference in Coal Used on Stoker-fired and Hand-fired Locomotives.
B. & O.....	Non-coking	10	Non-coking coal used in stokers and coking coal used in hand-fired engines.
Pennsylvania Lines	Non-coking bituminous from Indiana, Illinois, Pennsylvania and Ohio districts	6 to 16	Same coal used in each case.
B. R. & P.....	Very good quality of coking coal.	9 to 11	Nut and a mixture of nut and slack sometimes very fine slack for stokers. Run of mine used for hand-fired engines.
S. Louis & San Francisco.	Non-coking		Same coal used in each case.
Norfolk & Western.....	Run of mine bituminous	7 to 10	The run of mine coal is screened, the fine slack used on stokers, the lump on hand-fired engines.

a glance at the information is sufficient to show that the successful operation of the locomotive stoker as reported does not seem to be confined to any particular grade or character of fuel.

It is unfortunate that it has been impossible so far to secure definite data for the relative consumption of fuel with the stoker as compared with hand-firing. There are, however, some very elaborate tests under way, but they have not progressed sufficiently to justify reliable conclusions.

The relation of the stoker installation to the amount of tonnage handled, as against hand-firing, was also sought, and in reply to this query, roads using the stoker have expressed themselves as follows:

The Carolina, Clinchfield & Ohio reports heavier trains hauled, but does not say to what extent.

The Vandalia reports their stoker-fired engines consume about the same time on the division, but that a more uniform steam pressure is maintained.

The Baltimore & Ohio reports that it is possible to haul heavier trains with the stoker engines.

The Pennsylvania Lines West of Pittsburgh report 15 per cent. more tonnage hauled with stoker-fired engines on slow freight and on long, heavy grades.

The Buffalo, Rochester & Pittsburgh have not observed any difference between hand-firing and stoker operation.

The St. Louis & San Francisco reports better performance with stoker-fired engines, stating that some firemen are not able to keep up steam on heavy trains on the long runs.

The Norfolk & Western has not recognized any difference in tonnage rating between hand-fired and stoker-fired engines, since with but one exception all of their stokers are applied to one type of locomotive. It has been observed, however, that with the stoker operated properly the locomotive can be worked to its maximum capacity without any marked effect upon the steam pressure, which is a distinct advantage.

The Virginian Railway reports some improvement in steaming capacity and tonnage hauled, but does not give amounts.

A review of the reports clearly indicates that while all concede the stoker is capable of handling heavier tonnage, no road is ready to name the amount. Probably if such information had been secured, it might have proven to be widely different on the several roads on account of the existence of widely different operating conditions. The stoker, it is generally believed, is capable of firing a larger amount of fuel and still retain uniformity in its work, from which it follows that higher boiler power is reasonably sure, unless there is a failure from some other cause, but this increased capacity would not be shown in the starting of the locomotive. On the contrary, higher steam pressure maintained would result in higher tonnage, speed if desired, or more work performed by the locomotive.

On some roads where peculiar physical characteristics prevail with respect to ruling grades, etc., it might mean that an engine could be safely given a larger tonnage than had previously been handled, where the ability to start the train from the usual stopping points had not been a controlling factor in determining the tonnage rating.

Therefore, the question resolves itself to one where each road is better able to work out for itself the question of using the stoker with any return after taking into consideration the physical characteristics of the road, size of engines, tonnage now being hauled, and what advantages might accrue. The question

is rather one where it must be decided, first, if a more uniform rate of steaming is needed, and what expenditure might be warranted to secure such a condition.

Since with the scatter type of machine the arch brick is regarded as essential, and possibly of equal advantage in other types in the ratio of an engine with or without an arch hand-fired, it would seem its use may be a prime consideration, since it would seem to have a specific value.

A superheater can be introduced, carrying with it some 10 to 15 per cent. improvement in fuel or steaming capacity; and if still further advantage is desirable and the quality and quantity of fuel to be fired becomes a factor, the use of the stoker will be felt in the production of a uniform steam pressure, with possibly some saving in fuel where the conditions are equal, or higher steaming capacity with higher speed.

Where it is possible to keep the fire door closed, it must follow that the temperature in the firebox is more uniformly maintained, which in turn must result in better service conditions for the firebox, flue sheet and seams, otherwise our theories fall flat. As a matter of fact, observations, though limited, seem to indicate that the life of the flue is being increased, and equal results must necessarily be in store for the flue sheet and the firebox generally, but some allowance should be made for what is accomplished by the arch brick.

Very successful results can be obtained in the operation of the stoker, but some intelligence is necessary to make sure that it is allowed to work efficiently, and one of the most important features to be observed is to prevent the engine from continually popping off, wasting steam and fuel, but even this can be controlled, simply by the manipulation of apparatus requiring no other energy than ordinary attention. No particular effort, as a rule, is required to keep the stoker properly adjusted, working regularly, and free from clogging or disturbance to the uniform supply of fuel to the firebox. In the event of a failure of the stoker mechanism, the fireman, as a rule, can do but very little, except to resort to hand-firing, bringing the engine into terminal, where repairs can be made.

In handling stoker locomotives at terminals, or at ash pits along the road, there is some time to be saved, as the thinner fire can be knocked out or cleaned within ten or fifteen minutes time, as against probably twice the delay in handling a locomotive which has been hand-fired.

There is no doubt but that the maintenance of the stoker, by reason of its increased amount of machinery and working parts, is going to represent an item of repairs; and even if it has been rather low, as has been shown, some alteration in the figures is likely to take place as the stokers become older. It is also true that as the machines are improved and more substantial parts are applied, and greater proficiency in their manipulation is attained, there should be a corresponding improvement in the cost of maintenance. However, such items, including the time required to turn, repair, and otherwise put engines in shape for further service, should receive due consideration in summing up the net advantages derived by the stoker in service.

Reflecting for a moment upon the apparent work and interest manifested in the locomotive stoker, it is believed we must necessarily conclude that although the stoker has not been developed to a state of perfection, it has not only proven to be practical, but has demonstrated by service and endurance tests that it is of value, and that there is a growing field for its use.

In concluding, the committee wishes to show as a feature of this report what it concludes are some of the requirements which should, and in fact are being met in the satisfactory locomotive stoker.

1. It should convey coal from the tank to the firebox with the minimum of physical work on the part of the fireman.
2. It should maintain a maximum steam pressure on the locomotive, and have a margin for additional feeding capacity.
3. It should leave the firebox door, and deck as much as practicable, unobstructed.
4. It should maintain an ideal fire for economic fuel consumption.
5. It should distribute fuel in the firebox in such a manner as to reduce to a minimum any necessity for disturbing the fire by means of the hook.

The report is signed by:—A. Kearney (N. & W.), chairman; J. A. Carney (C. B. & Q.); Geo. Hodgins (Nat. Transcontinental Comm.); and J. M. James (P. R. R.).

DISCUSSION.

W. C. A. Henry, (Penna.): We have been making some road tests with locomotives fired with the Crawford stoker, in comparison with hand-fired locomotives. The object of these tests was to determine the relative maximum capacity of the stoker-fired locomotive in comparison with the hand-fired locomotive, and the relative economy also. The locomotive was of the consolidation type, weighing 250,000 lbs. and having a tractive power of 42,600 lbs. The grate area

was approximately 55 sq. ft. Brick arches were not used in any case as the fire box construction was too shallow to permit of their use.

The tests were made with run-of-mine coal which had not been selected in any way. The test-runs were 114 miles in length, and the draw-bar pull was obtained by a dynamometer. It was found that in all instances the stoker-fired locomotive gave a draw-bar pull of from 8 to 10 per cent. greater than the hand-fired locomotive. The hand-fired tests were made under conditions very much more severe than the ordinary working ones. The increased tractive power was due to the fact that the stoker would deliver more coal to the fire-box, than the fireman could deliver, and the fire-box had the capacity to burn it.

In one of these tests we got an average coal consumption of 8,415 lbs. per hour on the 114 mile run. This was for the time the throttle was actually open. In one of the hand-fired trips, we got a combustion rate of 7,146 lbs. per hour, but the fireman was receiving considerable assistance. On the trip having the high combustion rate, stoker-fired, the coal rate per square foot per hour was 152 lbs. It was also found that the equivalent evaporation per lb. of combustible was 5 per cent. greater for the stoker-fired than for the hand-fired locomotive.

Table II of the report gives the average of all the stokers since the first one was built, and includes the first one, where, as you all know, a successful trip is exceptional. In the last 60 trips, 59 of them were stoker-fired. One of them was 90 per cent. stoker-fired. The average for the 60 trips was 99.8 per cent. A similar stoker in freight service gives 97.3 per cent. These are all working on their runs and not operated under scientific conditions. The conclusion we feel there is no question that the stoker-fired locomotive will not limit the tonnage like a hand-fired locomotive, whereas it can be used to haul the same tonnage at higher speed. A division with a ruling grade, it will not haul any more but it will haul faster. On a low grade division, the stoker-fired locomotive will probably haul 15 per cent. more tonnage.

Smoke readings were also taken, and showed that a stoker-fired locomotive made one-third less smoke than the other, and at the same time dense black smoke was eliminated.

M. D. Franey (L. S. & M. S. Ry.): The stoker, like any other well designed machine, is capable of doing the work though it requires some expert attention. It is possible with the stoker, as it is with other mechanisms, to overdo it. If the machine is intelligently handled and is properly looked after, it is possible to get 100 per cent. efficiency out of it.

It should be considered the same as any other piece of mechanism that is attached to the locomotive. The stoker I have had experience with I am satisfied can do a little more work than the individual fireman, and I am also satisfied that it can give us as nearly 100 per cent. service as any other piece of mechanism we have attached to the locomotive.

M. A. Kinney (Hocking Valley): The Hocking Valley six months ago, purchased 6 Mikado engines weighing 325,000 lbs. with a tractive power of 60,800 lbs., having 66 sq. feet of grate surface, and equipped with a Street stoker. Our experience showed that the results depended largely on the quality of the coal which could be obtained. We use a large amount of so-called coarse slag, which requires some extra treatment to prepare it for the locomotive. Up to the present time, we are having successful trips with the stoker engines in every case. Tests made with the same engine between hand-firing and stoker firing have not developed any particular efficiency in economy of fuel per thousand ton miles, but as I stated, with the coal we have, we are able to obtain this thousand ton miles at a lower price, and the proposition has become very attractive to us. The mechanical maintenance of the stoker on our road is about the same as is reported by the committee. We have had in every case the best co-operation of the enginemen and firemen, especially the firemen.

D. R. McBain (L. S. & M. S.): I want to impress every person here with the idea that the stoker is coming mighty fast. There is nothing, in my opinion, which has made any greater strides toward perfection, from the time it was conceived up to the present time, than the stoker. I happened to have the privilege recently of looking at a stoker entirely different from anything which has ever been previously tried, and as far as I can see, it is as free from "bugs" as anything ever was at such an early stage of the game. So that I feel quite assured that at the end of four years more that the stoker will receive a great deal more consideration than it is given now.

Anous Sinclair: I had the privilege within the past month of riding on two locomotives equipped with the Street Stoker. I rode on the fastest freight train I have ever been on, a train weighing 3,500 tons, and which was running 50 m. p. h. for close on to 100 miles. Another engine, with a stoker, ran about the same distance and had a load of 6,000 tons.

I watched the operation of the stoker very carefully, and never saw any device of any kind or character that did the work more efficiently. I came to the conclusion that the stoker needs a skilful man to watch it. I think the stoker would fail in the hands of a careless fireman.

F. F. Gaines (Cent. of Ga.): There is no question the locomotive stoker has got to come with the large engines. On the other hand, there is another side to the whole thing which, while not decrying the stoker, I wish to call attention to for a minute. Six years ago, on our own particular road, with the class of power we had at that time, we were at the limit of the ability of the firemen to handle the engine, in fact, the tonnage was controlled by the ability of the fireman to put coal into the engine. Today, with larger grate areas, superheaters and other improvements, we are not only using larger engines with considerably more tractive power, but we are getting over the road more satisfactorily and burning less coal with the larger engines than formerly with the smaller engines, and while the improvements which have been made in the way of superheaters, large grate areas, etc., will draw a well-defined line between the hand-fired and stoker-fired engine, yet there is no question the stoker-fired engine has got to come.

T. N. Cook (Penna): In regard to the attitude of the crews towards the stoker, we have met with coolness and lack of co-operation on the part of the men until they become familiar with the apparatus. At first the enginemen are a little skeptical about the stoker, and it has been remarked with each type of stoker that has been put in service on any division, that there has been a characteristic performance. On the first going in of the stoker we get very good results, and then the results begin to drop down. These results, drawn in the form of a curve, make a big dip at one point, and then when the men get better acquainted with the stokers, the curve begins to rise and we get a greatly increased performance with them.

C. F. Street (Locomotive Stoker Co.): I once asked 15 or 20 firemen who were operating stokers on the Norfolk and Western how they liked the stoker and the universal reply was, "Mr. Street, that machine surely is the firemen's friend." and I understand it is pretty well known on the Norfolk & Western Railway as the firemen's friend. I feel that while the stoker is today doing its work and doing it perfectly satisfactorily, it is still capable of further development, and we expect to continue to develop it, as any other device must be capable of further development.

The thing we are now getting ready to do and are actively devoting our time to, is to find out the reasons why certain variations occur in stoker-firing. We will be able, I feel, to eliminate very many variables which have existed with the hand-firing of locomotives, and that we shall be able to get the problem of firing the locomotive down to a much more scientific basis than it has ever been before.

I think Mr. Kearney's statement that the physical characteristics of the coal, the preparation of the coal, has a greater influence on the operation of the stoker than the heat value of the coal, is one of a great deal of importance. It is not a difficult matter to take coal of any size and prepare it for the stoker. On one test made just a few days ago, we took a tank of coal which was half-bone and half coal. It was so low in heat value that it was impossible to maintain steam pressure with the locomotive standing. The best pressure we could get was about 100 lbs. As soon as we started out, the pressure went up quickly to the maximum, and there was no difficulty in maintaining the maximum pressure on the boiler with the boiler loaded to its full capacity. The ash-pan filled up very rapidly, of course. The coal which was used at that time was an experiment and was not taken as a practical working proposition. I think that that would indicate that the failure of engines from poor coal will, with the stoker, be largely eliminated.

D. Petrescu (Roumanian Government Railroad): I am an engineer connected with the Roumanian Government Railroad, and am very glad to be here with you to-day, and to be present at the discussion of this very important question which has troubled us for some time. The locomotive stoker is a thing which we, in our little country, wanted for our railway development. We use small engines, and had to use imported coal, having to pay very high prices for it. We had great difficulty in running engines with hand-firing. First of all, we could not get firemen sufficiently skilled to handle the coal, and we undertook bringing coal from England and abroad at a cost four times greater than is paid in this country. We found there were two things which we must have in hand-firing, a skilful fireman and a good quality of coal. To secure the last point, we had to pay a very great amount of money. We need big engines, but we found we cannot run big engines with hand-firing, and so we adopted the stoker loco-

tive, and although it is not paying to-day, yet the results are very promising. By the use of the big engines, we can economize and save something like 25 per cent. in the cost of fuel, compared with the engines which we previously used.

D. F. Crawford (Penna.): The development of the locomotive stoker on the Pennsylvania Lines was brought about by a desire to get more tons per train over the road. I have observed in the annual reports of many of the railroads that tons of train hauled per lb. of tractive power was decreasing as the engines grew larger. I found that locomotives 20 per cent. larger than other locomotives were hauling about the same trains and were not realizing the full 20 per cent. increase in tractive power. The stoker problem to me was one of decreased operating expenses by decreasing the train load for each unit on which we had to pay interest and maintenance charges. The stokers as they were first developed on our lines, were applied to the locomotives as they were. The locomotives had about 55 sq. ft. of grate. It was found that we could burn about 100 lb. of coal per sq. ft. of grate with reasonable economy. It was, therefore, my idea that the locomotives should burn 5,500 lb. of coal per hour instead of about 3,500 lb., as the actual records showed.

The results we have obtained have been so satisfactory and so promising, that we are building 110 locomotives in which we have increased the diameter of the cylinder 2 in. and depend on the stoker to put in enough coal to furnish the necessary steam. The first of these locomotives came out of the works this week.

In some of our experiments, we took one of our Consolidation locomotives and bored the cylinders out one inch, all that the metal would stand. While I am not sure that we will do it, we expect to bore all the rest out to the extent of one inch and get the benefit the increased cylinder area. I am satisfied from the performance of the locomotives on which we have made this change, that we can supply a sufficient amount of coal to take care of the larger cylinders. I see before us a locomotive still larger, that must have a stoker, because it will require so much coal per hour to supply. As evidence of my confidence in what we can do, the ordering of one hundred and ten locomotives, I think is sufficient.

As to the results obtained from the stoker in economy of fuel, I thought a good deal about that, and Mr. Henry has described to you some tests which we have made. Personally I do not put much store on tests. I would like much better to draw my conclusions from the record of a year. We will have on our line probably 300 locomotives equipped with stokers. At the end of one year I will take the fuel consumption of those locomotives and compare it with the fuel used by locomotives not fitted with stokers.

In a careful comparative test with picked men it was found that the hand-fired engines used 16 per cent. less coal than the stoker. I then took ten trips for each of ten firemen and did not weigh the coal, but averaged it up, and had it very carefully estimated; we only got 99 trips, as one trip did not have the necessary tonnage. These were the same firemen that used 16 per cent. less than the stoker used; and on the same run. Those same men then used 16 per cent. more than the stokers. In other words, what we have got to do, in my opinion, in order to ascertain what the stoker will do, is to compare it with the average result obtained by the firemen, and not test results.

We have had very careful records kept of the time required to handle hand-fed and stoker-fed locomotives in the engine houses. There have been variations in the records; sometimes the stoker engines required a little more. In the last week's report, laid on my desk, the stoker passenger engines averaged 12 minutes more in the engine house. Four hundred stoker freight engines were handled in some two minutes less than some 250 hand-fired engines. That means the total time the locomotive was in the engine house for repairs.

As to the mileage made by stoker engines: from our record, we obtained the average mileage of the hand-fired and stoker-fired engines on a division in a given month, and I think the stoker locomotives made about 100 miles more per month than the hand-fed engines. In other words, they were the same. Another month, and it was a little more favorable to the stoker engine. That is, with a number of stoker fed engines, the difference is inappreciable between the time required for handling, and the mileage obtained, between the stoker and the hand-fired locomotive. I think the development of the stoker is not a question of what the fireman can do with a locomotive as it exists, today, nor what he has done with the locomotive, in the past. It is what we are going to do with the locomotive; and what we are going to put behind it in earning capacity for the railways.

C. F. Street: Unless you use the miles per hour for coal,

your coal record is absolutely useless. I have seen a stoker-fed locomotive with the reverse lever in the corners working full stroke going 18 m. p. h., and no man or no ten men could keep up the steam on that locomotive working under those conditions. This train of 3,500 tons going at 50 m. p. h. was burning coal and the railway was getting results for that coal. That is your whole stoker proposition. The railroad is built to haul freight, and to get it over the road, and the most encouraging thing to me in this whole proposition is that the train dispatchers are the strongest advocates of the stoker.

H. T. Bentley (C. & N. W.): Ten or twelve years ago they made some experiments on the Chicago & North Western with powdered fuel, and we had several difficulties to contend with. The first was to keep the coal dust in the tank. We used the regular tank, and as we rushed along, the wind blew it all away. We also had coal in the fuel box. I can only say that in a general way we tried it, and we failed.

C. D. Young (Penna.): The Pennsylvania Railroad is arranging at present and has equipped itself to make some powdered fuel tests. This has come up in connection with our various schemes of study of different types of stokers. We have found with certain classes of coal, stokers most satisfactory on other kinds of coal, were not satisfactory; and the result we have had with the overfeed or scatter type has not been sufficiently encouraging to warrant the application of the scatter type. For that reason, we will make some preliminary experiments with powdered fuel on the locomotive type of boiler with the forced draft from a boiler steam supply, but not on a locomotive, in order to establish some data as to the burner and size, to see whether it is practicable to apply other fuel to the locomotive type of box, or to cement kilns, in order to get the desired feed capacity for heavy locomotive use.

We have considerable work with the under-feed or Crawford stoker, which does not use the shaking grates, or those ordinary applied to hand-fired locomotives and in comparing the results obtained, which are not entirely incomparable, owing to difference in size of boilers, it is our idea that the under-feed Crawford type is equally as efficient as the most skillful fireman that we employ. How much that would mean in six months or in one year's operation, we cannot say; but I am inclined to think that if a locomotive equipped with an under-feed stoker can equal the performance of a skilled fireman, you need have no great worry as to its economy. It may be interesting to some members to know what we have accomplished with the Schmidt superheater and the Crawford stoker. This boiler was equipped with a brick arch, and had a very large heating surface, the engine being the largest Pacific type in the country, having 27 in. x 28 in. cylinders. It gave an evaporation of 11.1 lbs. (reading from a curve) at 40 lbs. of coal per square foot of grate area which includes the area taken by the retorts; and equivalent evaporation was 6.7 at 140 lbs. per square foot of grate. At that rate, if we only figure the actual area of the grate bars, the firing rate, instead of being 140, would be 180 lbs. per square foot per hour.

In reviewing this locomotive, it was impossible to compare it with a hand-fed locomotive, as it was the only one of its kind which we had; and, therefore, our conclusions are drawn from the basis, largely, of performance in comparison with other locomotives. I will read you a little, in part, some of the conclusions drawn which bear directly on the questions asked: "A stoker, when applied to a boiler of this size, which is beyond the capacity of the fireman, justifies its application through the fact that the maximum power which the boiler is capable of developing can be obtained."

If we use 5,000 or 6,000 lbs. of coal, and this locomotive is capable of burning 10,000 lbs. per hour, or, say, if a fireman will feed 6,000 lbs. per hour, and the locomotive is capable of burning 10,000 with a stoker, it is then possible for you to obtain the maximum of that locomotive with the stoker, whereas you do not come to 60 per cent. of the maximum with the fireman.

"The application of the stoker is warranted on this locomotive in that at least 50 per cent. greater boiler power is obtained than would have been obtained with hand-firing, and its limitation of 5,000 lbs. of coal per hour." That is, assuming its capacity on a run which must be sustained for 2½ and 3 hours, this locomotive then would have 50 per cent. greater capacity than on a locomotive with a fireman. If the run was a short one, of say one hour, the figures should be reduced below 50. If a longer run, the stoker would even exceed that record.

"When the active grate area is not reduced by the application of the under-feed stoker, as much boiler power per square foot of active grate can be obtained when the stoker has been applied as when a boiler is skillfully hand-fired." We have proven it, and we know pretty well the characteristics of this fuel on these tests, and we know about what limitations of burning per square foot of grate was, and it

was found the application of the stoker did not reduce the coal per square foot of grate.

"Material reduction in smoke by the use of the stoker through a wide range of power was found possible, and compared with any hand-fired locomotive which has been tested. Excepting at very high rates of combustion, the furnace was found to be practically smokeless."

We then made some tests of scatter type stokers, but the information we have does not indicate that they evaporate as much water as skilled hand-fired, per pound of coal. Most of those tests were not with the latest development of the machine, or with brick arches, and did not represent the figures of present-day practice. It is my idea however, that if we have 15 in. of draft in a smoke-box and attempt to burn by a scatter type of a fine coal, that you will have difficulty in getting the capacity of a given coal we are supplying. I believe the larger development of the machine is in the direction of powdered fuel, and as you approach powdered fuel, it would be possible to obtain your large capacities at high firing rates, and for that reason we are trying to get some data on the necessary principles which must be observed in burning powdered fuel.

REVISION OF STANDARDS.

STANDARDS.

Screw Threads, Bolt Heads and Nuts.

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A member suggests that in accord with present practices the word "all" should be inserted in the second Resolution of 1886 before the word "flues" making the resolution read:

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A member calls attention to that part of the Resolution of 1906 which states that \$100 should be the limit distinguishing between running and shop repairs and suggests that in view of the present state of the act this figure is very low. The com-

tive, and although it is not paying to-day, yet the results are very promising. By the use of the big engines, we can economize and save something like 25 per cent. in the cost of fuel, compared with the engines which we previously used.

D. F. Crawford (Penna.): The development of the locomotive stoker on the Pennsylvania Lines was brought about by a desire to get more tons per train over the road. I have observed in the annual reports of many of the railroads that tons of train hauled per lb. of tractive power was decreasing as the engines grew larger. I found that locomotives 20 per cent. larger than other locomotives were hauling about the same trains and were not realizing the full 20 per cent. increase in tractive power. The stoker problem to me was one of decreased operating expenses by decreasing the train load for each unit on which we had to pay interest and maintenance charges. The stokers as they were first developed on our lines, were applied to the locomotives as they were. The locomotives had about 55 sq. ft. of grate. It was found that we could burn about 100 lb. of coal per sq. ft. of grate with reasonable economy. It was, therefore, my idea that the locomotives should burn 5,500 lb. of coal per hour instead of about 3,500 lb., as the actual records showed.

The results we have obtained have been so satisfactory and so promising, that we are building 110 locomotives in which we have increased the diameter of the cylinder 2 in. and depend on the stoker to put in enough coal to furnish the necessary steam. The first of these locomotives came out of the works this week.

In some of our experiments, we took one of our Consolidation locomotives and bored the cylinders out one inch, all that the metal would stand. While I am not sure that we will do it, we expect to bore all the rest out to the extent of one inch and get the benefit the increased cylinder area. I am satisfied from the performance of the locomotives on which we have made this change, that we can supply a sufficient amount of coal to take care of the larger cylinders. I see before us a locomotive still larger, that must have a stoker, because it will require so much coal per hour to supply. As evidence of my confidence in what we can do, the ordering of one hundred and ten locomotives, I think is sufficient.

As to the results obtained from the stoker in economy of fuel, I thought a good deal about that, and Mr. Henry has described to you some tests which we have made. Personally I do not put much store on tests. I would like much better to draw my conclusions from the record of a year. We will have on our line probably 300 locomotives equipped with stokers. At the end of one year I will take the fuel consumption of those locomotives and compare it with the fuel used by locomotives not fitted with stokers.

In a careful comparative test with picked men it was found that the hand-fired engines used 16 per cent. less coal than the stoker. I then took ten trips for each of ten firemen and did not weigh the coal, but averaged it up, and had it very carefully estimated; we only got 99 trips, as one trip did not have the necessary tonnage. These were the same firemen that used 16 per cent. less than the stoker used; and on the same run. Those same men then used 16 per cent. more than the stokers. In other words, what we have got to do, in my opinion, in order to ascertain what the stoker will do, is to compare it with the average result obtained by the firemen, and not test results.

We have had very careful records kept of the time required to handle hand-fed and stoker-fed locomotives in the engine houses. There have been variations in the records; sometimes the stoker engines required a little more. In the last week's report, laid on my desk, the stoker passenger engines averaged 12 minutes more in the engine house. Four hundred stoker freight engines were handled in some two minutes less than some 250 hand-fired engines. That means the total time the locomotive was in the engine house for repairs.

As to the mileage made by stoker engines: from our record, we obtained the average mileage of the hand-fired and stoker-fired engines on a division in a given month, and I think the stoker locomotives made about 100 miles more per month than the hand-fed engines. In other words, they were the same. Another month, and it was a little more favorable to the stoker engine. That is, with a number of stoker fed engines, the difference is inappreciable between the time required for handling, and the mileage obtained, between the stoker and the hand-fired locomotive. I think the development of the stoker is not a question of what the fireman can do with a locomotive as it exists, today, nor what he has done with the locomotive, in the past. It is what we are going to do with the locomotive; and what we are going to put behind it in earning capacity for the railways.

C. F. Street: Unless you use the miles per hour for coal,

your coal record is absolutely useless. I have seen a stoker-fed locomotive with the reverse lever in the corners working full stroke going 18 m. p. h., and no man or no ten men could keep up the steam on that locomotive working under those conditions. This train of 3,500 tons going at 50 m. p. h. was burning coal and the railway was getting results for that coal. That is your whole stoker proposition. The railroad is built to haul freight, and to get it over the road, and the most encouraging thing to me in this whole proposition is that the train dispatchers are the strongest advocates of the stoker.

H. T. Bentley (C. & N. W.): Ten or twelve years ago they made some experiments on the Chicago & North Western with powdered fuel, and we had several difficulties to contend with. The first was to keep the coal dust in the tank. We used the regular tank, and as we rushed along, the wind blew it all away. We also had coal in the fuel box. I can only say that in a general way we tried it, and we failed.

C. D. Young (Penna.): The Pennsylvania Railroad is arranging at present and has equipped itself to make some powdered fuel tests. This has come up in connection with our various schemes of study of different types of stokers. We have found with certain classes of coal, stokers most satisfactory on other kinds of coal, were not satisfactory; and the result we have had with the overfeed or scatter type has not been sufficiently encouraging to warrant the application of the scatter type. For that reason, we will make some preliminary experiments with powdered fuel on the locomotive type of boiler with the forced draft from a boiler steam supply, but not on a locomotive, in order to establish some data as to the burner and size, to see whether it is practicable to apply other fuel to the locomotive type of box, or to cement kilns, in order to get the desired feed capacity for heavy locomotive use.

We have considerable work with the under-feed or Crawford stoker, which does not use the shaking grates, or those ordinary applied to hand-fired locomotives and in comparing the results obtained, which are not entirely incomparable, owing to difference in size of boilers, it is our idea that the under-feed Crawford type is equally as efficient as the most skillful fireman that we employ. How much that would mean in six months or in one year's operation, we cannot say; but I am inclined to think that if a locomotive equipped with an under-feed stoker can equal the performance of a skilled fireman, you need have no great worry as to its economy. It may be interesting to some members to know what we have accomplished with the Schmidt superheater and the Crawford stoker. This boiler was equipped with a brick arch, and had a very large heating surface, the engine being the largest Pacific type in the country, having 27 in. x 28 in. cylinders. It gave an evaporation of 11.1 lbs. (reading from a curve) at 40 lbs. of coal per square foot of grate area which includes the area taken by the retorts; and equivalent evaporation was 6.7 at 140 lbs. per square foot of grate. At that rate, if we only figure the actual area of the grate bars, the firing rate, instead of being 140, would be 180 lbs. per square foot per hour.

In reviewing this locomotive, it was impossible to compare it with a hand-fed locomotive, as it was the only one of its kind which we had; and, therefore, our conclusions are drawn from the basis, largely, of performance in comparison with other locomotives. I will read you a little, in part, some of the conclusions drawn which bear directly on the questions asked: "A stoker, when applied to a boiler of this size, which is beyond the capacity of the fireman, justifies its application through the fact that the maximum power which the boiler is capable of developing can be obtained."

If we use 5,000 or 6,000 lbs. of coal, and this locomotive is capable of burning 10,000 lbs. per hour, or, say, if a fireman will feed 6,000 lbs. per hour, and the locomotive is capable of burning 10,000 with a stoker, it is then possible for you to obtain the maximum of that locomotive with the stoker, whereas you do not come to 60 per cent. of the maximum with the fireman.

"The application of the stoker is warranted on this locomotive in that at least 50 per cent. greater boiler power is obtained than would have been obtained with hand-firing, and its limitation of 5,000 lbs. of coal per hour." That is, assuming its capacity on a run which must be sustained for 2½ and 3 hours, this locomotive then would have 50 per cent. greater capacity than on a locomotive with a fireman. If the run was a short one, of say one hour, the figures should be reduced below 50. If a longer run, the stoker would even exceed that record.

"When the active grate area is not reduced by the application of the under-feed stoker, as much boiler power per square foot of active grate can be obtained when the stoker has been applied as when a boiler is skillfully hand-fired." We have proven it, and we know pretty well the characteristics of this fuel on these tests, and we know about what limitations of burning per square foot of grate was, and it

was found the application of the stoker did not reduce the coal per square foot of grate.

"Material reduction in smoke by the use of the stoker through a wide range of power was found possible, and compared with any hand-fired locomotive which has been tested. Excepting at very high rates of combustion, the furnace was found to be practically smokeless."

We then made some tests of scatter type stokers, but the information we have does not indicate that they evaporate as much water as skilled hand-fired, per pound of coal. Most of those tests were not with the latest development of the machine, or with brick arches, and did not represent the figures of present-day practice. It is my idea however, that if we have 15 in. of draft in a smoke-box and attempt to burn by a scatter type of a fine coal, that you will have difficulty in getting the capacity of a given coal we are supplying. I believe the larger development of the machine is in the direction of powdered fuel, and as you approach powdered fuel, it would be possible to obtain your large capacities at high firing rates, and for that reason we are trying to get some data on the necessary principles which must be observed in burning powdered fuel.

REVISION OF STANDARDS.

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mittee concurs in the recommendation and would refer it to the convention for consideration.

NEW BUSINESS.

A member suggests the adoption of standard dimensions for flange couplings for injectors, as such couplings have begun to supersede the older forms of screw couplings. The committee concurs in this recommendation and suggests that it be referred to a special committee with instructions to cover the subject of screw couplings as well.

A member recommends for adoption as Standard of: Specifications for rolled steel wheels as adopted by M. C. B. letter ballot 1912 or specification for solid wrought steel wheels.

Rotundity gage for steel wheels.

Plane gage for steel wheels.

Gage for measuring thickness of rim.

Method of branding steel wheels.

The committee does not concur in this recommendation.

The committee desires to call the attention of the Association to the comparatively few replies to its inquiries as made by circular. With an active membership of more than one thousand, but twenty replies were made. Of these twenty, there were five who made no reply to the direct inquiry as to the extent to which the Standards were used. The remaining fifteen indicated an adherence to the Standards in all details of from 25 per cent. to 100 per cent., very few following in full the specifications as given for materials, alterations more or less extensive being indicated in most cases.

It is also noted that out of the full membership only 180 voted the "Letter Ballot" and several standards were adopted on the approval of only one-eighth of the membership.

The committee, therefore, recommends that:

For the purpose of developing and shaping standards to a suitable form for universal adoption by the members the association should have and use "Recommended Practice."

No standard should be adopted until it has been a recommended practice for at least one year.

A standard should require such a substantial approval of the full active membership and the full railroad representative membership on the basis of one additional vote for 100 locomotives represented as will insure its being generally used.

Whenever the association deems it advisable to alter any present, or prepare new specifications for material in which other recognized societies are interested, that the committee in charge of the work should be instructed to request the coöperation of those societies in preparing the specifications.

The report is signed by:—W. E. Dunham (C. & N. W.), chairman; M. H. Haig (A. T. & S. F.), and A. R. Ayers (N. Y. C.).

DISCUSSION.

The secretary was instructed to make the changes requested; the items involving the appointment of special committees and those to be acted on by the association were left to the incoming executive committee.

J. F. DeVoy, (C. M. & St. P.): I would like to ask what the committee had in mind when it concurred in the recommendation for dropping the specifications for wrought iron axle?

W. E. Dunham: At the present time, iron axles are not bought. We did not believe specifications could be made to cover an iron axle now.

Mr. DeVoy: In view of the explanation, we would object to having it dropped. We want the privilege of using a wrought iron axle in cases of necessity.

Secretary Taylor: Mr. DeVoy will have the privilege of objecting to it in the letter ballot.

F. F. Gaines: One other question I would like to bring up:—The committee has turned down the 6 in. x 11 in. journal box. Inasmuch as the Master Car Builders' Association will unquestionably bring out that design before another year passes, I should ask that the committee incorporate the 6 in. x 11 in. M. C. B. in ours. We should also adopt the M. C. B. rolled steel wheel unless there are some substantial reasons for not doing so.

W. E. Dunham: Our reason for holding back on the box for the 6 in. x 11 in. axle was the fact that that is only being developed by the M. C. B. Association at this time, and will be a recommended practice of theirs for at least one year; and we did not believe the Master Mechanics should adopt as a standard what is yet recommended practice. The same applies to the rolled steel wheel.

F. F. Gaines: Everyone is using the 6 in. x 11 in. axle journal, and if we cannot have it as standard practice, we should at least have it as recommended practice.

W. E. Dunham: This association has no recommended practice, and the committee does not feel that it wanted to make it a standard.

William Garstang (C. C. C. & St. L.): I make a motion that

no standard of this association be adopted until after it has been given at least one year as recommended practice. (The motion was carried.)

F. F. Gaines: I now make the motion that the 6 in. x 11 in. journal box be adopted as recommended practice, and that the committee conform to the M. C. B. standard as far as they have gone, and include it in their final report. (The motion carried.)

F. F. Gaines: I now make the motion that items suggested by the committee be referred to letter ballot.

J. F. DeVoy: We would like to vote for the motion as it stands, with the exception that article 32 (dropping iron axle specifications) be dropped for the reason that it might be commercially to our advantage to have it in any case.

F. F. Gaines: Mr. DeVoy and everyone has perfect liberty to vote on that as he wishes; but as long as the iron axle has been brought up, I do not think even if the commercial possibility of the iron axle is here, I do not think we should encourage it. I think they are unreliable, and I think we should now discourage their use, as an Association.

J. F. DeVoy: We do not feel this Convention should put its condemnation on that specification which harms no one and does no good. The discussion of the iron axle will take more time than Mr. Gaines or myself will have for the next year. I cannot see what harm there is in leaving it in.

Mr. Gaines' motion was carried.

LOCATION OF PUBLIC STENOGRAPHER.

L. H. Marbel, official public stenographer for the exhibitors and members, is located in the balcony of the pier.

FOUND.

A bar pin has been found on the pier and will be delivered on identification at the office of Secretary J. D. Conway, of the Railway Supply Manufacturers' Association.

MASTER MECHANICS' DANCE.

A social gathering and informal dance was held at 9 P. M. last night at the Blenheim Exchange, Marlborough-Blenheim hotel, following the precedent set last year, and was well attended. The following committee was in charge: Edwin F. Chaffee, L. B. Sherman, H. A. Nealley, E. H. Janes, J. B. Purcell, W. J. Caton, H. O. Fettinger and H. J. Sheridan.

NEW LOCOMOTIVES FOR THE L. & N.

In commenting on the work which is being done at the South Louisville shops of the Louisville & Nashville in Wednesday's *Daily* the statement was made that practically all of the new locomotives for that road are built in its own shops and that they were being turned out at the rate of one a month. This is a grievous error and hardly fair to the L. & N. Just now the rate is one a week, which is far more creditable.

R. S. M. A. NOMINATIONS.

At a meeting of the Nominating Committee of the Railway Supply Manufacturers' Association, held yesterday afternoon, Benjamin A. Hegeman, Jr., now vice-president, was named for president, and J. Will Johnson, chairman of the Exhibit Committee, was nominated to succeed Mr. Hegeman. The Nominating Committee consists of Messrs. Blakeslee (chairman), Nellis, Ostby, Reilly, Johnson, Morton and Dolan, each representing one of the seven geographical districts into which the association is divided.

ENTERTAINMENT COMMITTEE.

The entertainment committee has a meeting every morning except Saturday in the balcony above the registration booth to arrange the details of the day's entertainment program.

NEW HONORARY MEMBERS OF M. M. ASSOCIATION.

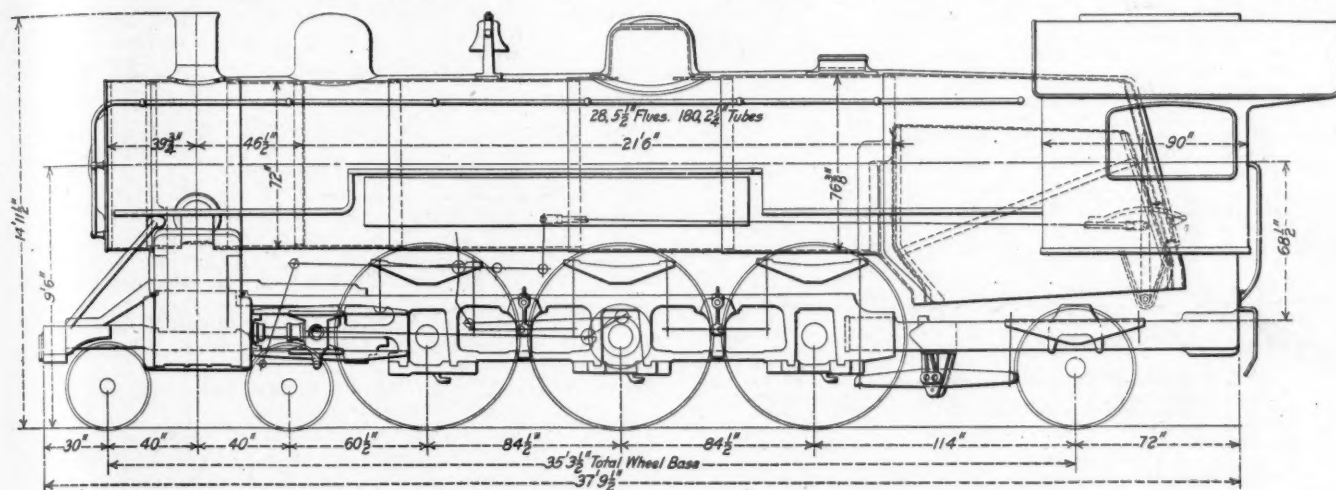
At the meeting of the association yesterday the following members were elected to honorary membership: L. C. Noble, a member since 1875; J. S. Cook, a member since 1879; E. L. Weisgerber, a member since 1886; W. S. Morris, a member since 1887 and a past president; A. M. Waitt, a member since 1892 and a past vice-president; E. E. Davis, a member since 1893; C. T. McElvaney, a member since 1893, and E. L. Walton, a member since 1896.

4-6-2 TYPE LOCOMOTIVE FOR THE NEW HAVEN.

The New York, Haven and Hartford recently received, from the Baldwin Locomotive Works, six Pacific type locomotives which develop about 10 per cent. greater tractive effort than

and by-pass valves; also with the Wildin automatic valve, developed on this road for admitting a small supply of saturated steam to the cylinders when drifting. The valve gear is of the Walschaert type, the arrangement being generally similar to that used on the previous locomotives. The radius rods are supported directly by the lifting arms of the reverse shaft, instead of being suspended from links, as is frequently done with this form of gear.

The main frames, together with the double front rails and driving pedestal braces, are of vanadium cast steel; the rear frame sections are of forged iron. The pedestal shoes and wedges are of Hunt-Spiller iron. The top and bottom rails of the main frames are braced transversely, mid-way between adjacent driving axles. A vertical expansion plate is bolted to both cross-ties, and is extended upward, forming a support



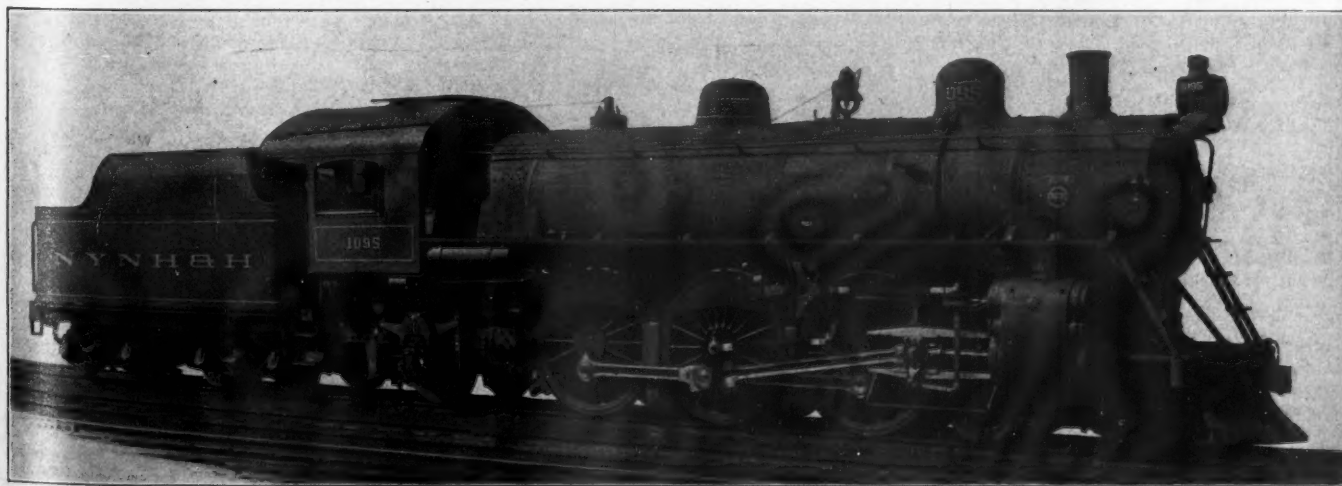
Elevation of Powerful Pacific Type Locomotive for the N. Y., N. H. & H.

the engines of the same type that have been in service since 1907. The new locomotives use superheated steam, and on a heating surface basis, show a superiority of 13 per cent. over the previous design. The tractive effort is 34,600 lbs., and the ratio of adhesions 4.42. The wheel diameter has been increased from 73 in. to 79 in., thus giving the new locomotives an advantage in high speed service. The proportions of the two designs, as far as relative steaming capacity is concerned, are very similar.

The use of superheated steam in the new engines has necessitated the application of piston valves, in place of the slide valves heretofore employed. The cylinders are fitted with relief

for the boiler barrel. These expansion plates are secured to steel saddle shaped castings which are secured to the boiler shell, and are used instead of the usual T- or angle irons. At the rear end of the boiler barrel is a third expansion plate, and this is bolted to a tie which is placed over the back driving pedestals. A substantial steel casting acts as a transverse brace at the point where the rear frames are spliced to the main frames, and also supports the radius-bar pin for the back engine truck and the carrying-plate for the forward end of the firebox.

The boiler barrel is straight; and the dome is formed from a single piece of flanged steel, 33 inches in diameter and 22 inches in height. All staybolts in the water legs are flexible, and four



Superheater Passenger Locomotives, New York, New Haven & Hartford.

rows of flexible bolts support the forward end of the crown sheet. The firebox contains a security sectional brick arch.

The driving and back engine truck axles are of heat-treated, oil tempered steel. Brake shoes are applied to all wheels under the locomotive and tender. The general dimensions, weights and ratios are as follows:

GENERAL DATA.	
Service	Passenger
Fuel	Bit coal
Tractive effort	34,600 lbs.
Weight in working order	246,200 lbs.
Weight on drivers	153,100 lbs.
Weight on leading truck	49,100 lbs.
Weight on trailing truck	44,000 lbs.
Weight of engine and tender in working order	365,000 lbs.
Wheel base, driving	14 ft. 1 in.
Wheel base, total	35 ft. 3 1/2 in.
Wheel base, engine and tender	63 ft. 4 1/2 in.
RATIOS.	
Weight on drivers ÷ tractive effort	4.42
Total weight ÷ tractive effort	7.10
Tractive effort x diam. drivers ÷ evaporating heating surface	815.00
Total evaporating heating surface ÷ grate area	62.80
Firebox heating surface ÷ total evaporating heating surface, per cent.	6.70
Weight on drivers ÷ total evaporating heating surface	45.50
Total weight ÷ total evaporating heating surface	73.00
CYLINDERS.	
Kind	Simple
Diameter and stroke	24 in. x 28 in.
VALVES.	
Kind	Piston
Diameter	12 in.
Lead	5-16 in.
WHEELS.	
Driving, diameter over tires	79 in.
Driving, thickness of tires	3 1/2 in.
Driving journals, diameter and length	10 in. x 12 in.
Engine truck wheels diameter	36 1/4 in.
Engine truck journals	6 in. x 12 in.
Trailing truck wheels, diameter	51 in.
Trailing truck, journals	8 in. x 14 in.
BOILER.	
Style	Straight
Working pressure	200 lbs.
Outside diameter of first ring	72 in.
Firebox, length and width	108 1/4 in. x 71 1/4 in.
Firebox plates, thickness	3/4 in. & 1/2 in.
Firebox, water space	F-5 in. S. & B-4 in.
Tubes, number and outside diameter	180-2 1/4 in.
Flues, number and diameter	28-5 1/2 in.
Tubes and flues, length	21 ft. 6 in.
Heating surface, tubes	3132 sq. ft.
Heating surface, firebox	223 sq. ft.
Heating surface, total	3355 sq. ft.
Superheater heating surface	730 sq. ft.
Grate area	53.5 sq. ft.
TENDER.	
Water capacity	6000 gals.
Coal capacity	13 tons

MASTER MECHANICS' REGISTRATION.

Allen, G. S., M. M. (Retired), P. & R. Pennhurst.
 Appller, A. B., M. E., Del. & Hudson Co., Marlborough-Blenheim.
 Ayers, A. K., G. M. E., N. Y. C. Lines, Marlborough-Blenheim.
 Benjamin, C. M., Dean Eng. Schools, Pierrepont.
 Bennett, W. H., M. M., Penna. R. R., Traymore.
 Beyer, O. S., Jr., Gen. For., Rock Island Lines, Chalfonte.
 Bingaman, C. A., Engr. Tests, Phila. & Reading R. R.
 Black, W. G., M. M., N. Y. C. & St. L., Chester Inn.
 Bowles, C. K., M. M., Tidewater & Western R. R., Channell.
 Brandt, C. A., M. E., C. C. C. & St. L. Ry., Marlborough-Blenheim.
 Brown, M. C., S. M. P., Gulf & Ship Island, Haddon Hall.
 Burton, T. L., Marlborough-Blenheim.
 Bush, S. P., G. M., Steel Castings Co., Brighton.
 Butler, F. A., M. M., B. & O., Marlborough-Blenheim.
 Canfield, J. B., M. M., Boston & Albany R. R., Schlitz.
 Carroll, J. T., Supt. M. P., B. & O. R. R., Marlborough-Blenheim.
 Carroll, W. P., M. M., N. Y. C. Lines, Marlborough-Blenheim.
 Clark, J. H., M. M., S. I. Rap. Tran. Ry., Marlborough-Blenheim.
 Coddington, H. W., Engr. of Tests, N. & W., Traymore.
 Cooper, F. R., Arlington.

Cox, Millard F., M. E., L. & N. R. R., Chalfonte.
 Cromwell, O. C., M. E., B. & O. R. R., Marlborough-Blenheim.
 Dalton, Wm., Chief Engr., American Loco. Co., Traymore.
 Darlwe, A. M., Supt. M. P., Buffalo & Sus. R. R., Chalfonte.
 Deeter, D. H., M. M., P. & R., Jackson.
 Delaney, C. A., Traymore.
 Dickerson, S. E., Supt. M. P., C. C. C. & St. L. Ry., Marlborough-Blenheim.
 Diehr, C. P., Road Foreman of Engrs., N. Y. C. & H. R. R. R.
 Dillon, S. J., M. M., Penna.
 Dimitril, Petrescu, M. E., Roumanian Govt. Rys., Monticello.
 Duffey, G. J., M. M., L. E. & W. Ry., Marlborough-Blenheim.
 Dunn, J. F., Asst. Gen. Mgr., O S. L. R. R., Chalfonte.
 Emory, John B., M. M., T. & Ft. S. Ry., Chalfonte.
 Evans, G. L., Supt. Shops, Can. Pacific Ry., Traymore.
 Fetner, W. H., M. M., Central of Georgia Ry., Chalfonte.
 Fitzmorris, Jas., M. M., Chicago Junct. Ry., Lexington.
 Flanagan, M., M. M., Ches. & Ohio Ry., Haddon Hall.
 Flavin, J. T., M. M., C. I. & S. R. R., Marlborough-Blenheim.
 Fowler, Geo. L., Consulting Engr., Dennis.
 Fowler, H., C. M. E., Midland Ry. of England, Brighton.
 Franey, M. D., M. M., L. S. & M. S. Ry., Traymore.
 Gaspar, Charles, Traymore.
 Gibbs, A. W., Chief M. E., Penna. R. R., Chelsea.
 Glass, John C., M. M., Penna.
 Goodrich, Geo. P., M. M., Ft. Smith & Western, Lexington.
 Goodrich, Max, M. M., N. Y. & Ottawa, New Hattand.
 Gordon, H. D., Marlborough-Blenheim.
 Graburn, A. L., M. E., Can. Northern Ry., Shelburne.
 Greenwood, H. F., Supt. Shops, N. & W. Ry., Strand.
 Grewe, H. F., M. M., W. P. T. & W. S. B., Brighton.
 Gross, E. G., M. M., Central of Ga. Ry., Haddon Hall.
 Haug, Harry, M. M., Brownstone & Middletown Ry., De Ville.
 Hayes, H. B., M. M., Alabama Great Southern, Dennis.
 Hayes, W. C., Supt. Loco. Oper's, Erie R. R., Chalfonte.
 Henderson, Geo. R.
 Henry, W. C. A., Supt. M. P., Penna. Lines, W., Shelburne.
 Hill, Jno. P., Div. St. Keeper, Penna.
 Hill, W. H., M. M., Cornwall R. R., De Ville.
 Hogan, C. H., Supt. Motive Power, N. Y. C. & H. R. R. R.
 James, J. M., Supt. M. P., P. R. R., Marlborough-Blenheim.
 Jaynes, R. T., M. M., Lehigh & Hudson R., Traymore.
 Jones, L. B., Asst. Eng. M. P., Penna., Brighton.
 Kantmann, A. G., Supt. Mach., N. C. & St. L. Ry., Chalfonte.
 Kearney, A., Asst. Supt. M. P., N. & W. Ry., Marlborough-Blenheim.
 Keiser, C. B., M. M., Penna. R. R., Traymore.
 Kiesel, W. F., Jr., Asst. Mech. Engr., Penna., Chelsea.
 Kleine, R. L., Gen. Car Inspt., Penna. R. R., Dennis.
 Kneass, S. L., Chalfonte.
 Kuhn, W. T., M. M., T. H. & B. Ry., Traymore.
 Kyle, C., M. M., Can. Pacific Ry., Haddon Hall.
 Larry, W. L., Mass. R. R. Co., Chalfonte.
 Little, J. C., M. E., Chic. & Northwestern Ry., Shelburne.
 Manning, J. H., Supt. M. P., D. & H. Co., Marlborough-Blenheim.
 Markey, Jas., M. M., Grand Trunk Ry., Haddon Hall.
 Marsh, F. E., Asst. M. M., Penna. R. R., Shelburne.
 Maxfield, H. H., M. M., Penna. R. R., Chalfonte.
 McIlvaine, C. L., Asst. Engr. M. P., Penna. R. R., Brighton.
 McNulty, F. M., Supt. M. P. & R. S., Mon. Con., Chalfonte.
 McRae, J. A., Mach. Engr., Mich. Cen., Chalfonte.
 Meade, P. J., M. M., Atlantic Coast Line R. R., Chalfonte.
 Meehan, J. L., M. M., Ashland Coal & Iron Ry., Traymore.
 Mellin, C. J., Traymore.
 Mengel, J. C., M. M., Penna. R. R., Chalfonte.
 Meredith, H. P., M. M., Balt. Div., N. C. Ry., Traymore.
 Milliken, Jas., Supt. M. P., P. B. & W. Ry., Brighton.
 Minshall, P. H., M. M., N. Y. C. & W. R. R., Traymore.
 Monfee, A. J., M. M., Birm. Southern Ry., Birmingham.
 Muchnic, C. M., Marlborough-Blenheim.
 Mullen, D. J., M. M., C. C. C. & St. L. Ry.
 Newhouse, J. F., Man., C. & I. Ter. Ry., Lexington.
 Noble, L. C., The Strand.
 O'Hearne, J. A., S. M. P. C. & A., Marlborough-Blenheim.
 Ord, C. R., M. M., Can. Pacific Ry., Haddon Hall.
 Owens, W. H., M. M., Southern Ry., Channell.
 Page, Chas. N., M. M., Lehigh Valley, Arlington.
 Painter, J. H., Supt. Shops, At. Coast Line R. R., Chalfonte.
 Paul, W. M., M. M., Galv. Hous. & Hend'sn R. R., Schlitz.
 Perrine, W. M., M. M., Cen. R. R. of N. J., Pennhurst.
 Phillips, C., M. M., N. O. & N. E. R. R., Brighton.
 Pilcher, John A., M. E., Norfolk & Western Ry., Traymore.
 Poole, A. J., Supt. M. P., Seaboard Air Line Ry., Marlborough-Blenheim.
 Potts, C. H., M. M., Penna. R. R., Chalfonte.

Redding, D. J., Asst. S. M. P., Pittsburgh & L. E., Traymore.
 Reynolds, O. H., Dennis.
 Rhuark, F. W., M. M., Balto. & Ohio, Pennington.
 Rhuark, F. W., M. M., B. & O., Pennington.
 Richardson, L. A., Mech. Supt., Rock Island, Dennis.
 Rink, Geo. W., M. E., Cen. R. R. of N. J., Dennis.
 Robb, J. M., Marlborough-Blenheim.
 Robb, W. D., Supt. M. P., G. T. L., Marlborough-Blenheim.
 Schlafge, Wm., Gen. Mech. Supt., Erie R. R., Strand.
 Schmidt, Prof. E. C., Haddon Hall.
 Seabrook, C. H., Supt. Mach., Int. & Gt. Nor. R. R., Traymore.
 Seddon, C. W., Supt. M. P., D. M. & N. Ry., Traymore.
 Sedgwick, E. V., Hon. Mem. A. R. M. M. A., Strand.
 Sheafe, J. S., Engr. Tests, Ill. Cen. R. R., Dennis.
 Sinclair, Angus, Erie R. R., Marlborough-Blenheim.
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 Small, H. J., Gen. Supt. M. P., Southern Pacific, Marlborough-Blenheim.
 Small, H. J., Gen. Supt. M. P., Sou. Pac., Marlborough-Blenheim.
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 Staley, H. F., M. M., Care Clinchfield & Ohio Ry., Traymore.
 Stockton, James, M. M., New Orleans Term. Co., Lexington.
 Street, C. F., Marlborough-Blenheim.
 Stuart, C. M., M. M., Phila. & Reading, Pennhurst.
 Sweeley, E. H., Gen. For. Loco. Reps., L. I., Dennis.
 Terrell, C. H., Asst. S. M. P., Ches. & O. Ry., Haddon Hall.
 Thomas, J. J., Jr., Supt. M. P., Sou. Ry. Co. in Miss., Strand.
 Trumbull, A. G., Mech. Supt., Erie R. R., Chalfonte.
 Tuma, Frank, M. M., Erie R. R., Marlborough-Blenheim.
 Van Doren, G. L., Supt. Shps., C. R. R. of N. J., Worthington.
 Waitt, A. M.
 Walker, H. E., Ch. Mech. Eng., Buenos Aires Great Southern, Strand.
 Walsh, Frank J., M. M., Ches. & Ohio Ry.
 Walsh, Wm. F., Traymore.
 Warthen, H. J., M. M., Wash. S. Ry., Channell.
 Warthen, J. C., M. M., Danville & Western Ry., Monticello.
 Watters, J. H., Asst. M. M., G. R. R., Marlborough-Blenheim.
 Whyte, F. M., Marlborough-Blenheim.
 Wyman, R. L., M. M., Lehigh & New England, Pennhurst.
 Young, C. B., M. E., C. B. & Q. R. R., Traymore.
 Young, C. D., Engr. Tests, Penna. R. R., Brighton.

MASTER CAR BUILDERS' REGISTRATION.

Appler, A. B., Mechanical Engineer, Delaware & Hudson Co., Marlborough-Blenheim.
 Ayers, A. R., General Mechanical Engineer, N. Y. Central Lines, West, Marlborough-Blenheim.
 Brandt, C. A., M. E., C. C. C. & St. L. Ry., Marlborough-Blenheim.
 Brown, M. G., S. M., Gulf & Ship Island, Haddon Hall.
 Clark, J. H., M. M., Staten Island Rapid Transit Ry., Marlborough-Blenheim.
 Cook, T. R., Asst. Engr. Motive Power, Penna. Lines, West, Brighton.
 Cromwell, O. C., M. Engineer, B. & O. R. R., Marlborough-Blenheim.
 Darlow, A. M., Supt. Motive Power, Buffalo & Susquehanna R. R., Chalfonte.
 Dickerson, S. K., Supt. Motive Power, C. C. C. & St. L. Ry.
 Dillon, S. J., M. M., Penna.
 Dolan, J. P., M. M., Mo. & N. Arkansas R. R., Lexington.
 Duffey, G. J., M. M., Lake Erie & Western Ry., Marlborough-Blenheim.
 Dunn, J. F., Asst. General Manager, Oregon Short Line R. R., Chalfonte.
 Ettenger, R. L., Chief Mechanical Engineer, Southern Ry., Dennis.
 Fitzmorris, Jas., M. M., Chicago Junction Ry., Lexington.
 Fowler, G. L., Dennis.
 Fox, Geo. P., Dis. Gen. Car For., N. Y. C. & H. R., Pennhurst.
 Graburn, A. L., M. Engineer, Canadian Northern Ry., Shelburne.
 Gibbs, A. W., Chief Mechanical Engineer, Penna. R. R., Chelsea.
 Goodrich, G. P., M. M., Ft. Smith & Western R. R., Lexington.
 Goodrich, Max, Gen. For., N. Y. & Ottawa, New Hattand.
 Grieves, E. W., Marlborough-Blenheim.
 Henry, W. C. A., Supt. M. P., Penna. Lines, West, Shelburne.
 James, J. M., Supt. Motive Power, Penna. R. R., Marlborough-Blenheim.
 Jones, L. B., Asst. Eng. M. P., Penna., Brighton.
 Kantmann, A. G., Supt. Machinery, Nashville, Chattanooga & St. L. R. R., Chalfonte.

Kearney, A., Asst. Supt. Motive Power, Norfolk & Western Ry., Marlborough-Blenheim.
 Kiesel, W. F., Asst. Mech. Eng., Penna., Chelsea.
 Kleine, R. L., General Car Inspector, Penna. R. R., Dennis.
 Kuhn, W. T., M. M., Tor., Ham'tn & Buffalo, Traymore.
 LaMar, A., M. M., Penna. Co., N. W. System, Dennis.
 Manning, J. H., Supt. Motive Power, Delaware & Hudson Co., Marlborough-Blenheim.
 McIlvaine, C. L., Asst. Engr. Motive Power, Penna. R. R., Brighton.
 McNulty, F. M., Supt. M. P. & R. S., Monongahela Con., Chalfonte.
 McRae, J. A., Mech. Engr., Mich. Cen., Chalfonte.
 Mengel, John C., M. M., Penna. R. R., Chalfonte.
 Milliken, Jas., Supt. M. P., P. B. & W., Brighton.
 Mirtz, P. P., M. Engineer, L. S. & M. S. Ry., Traymore.
 Monfee, A. J., M. M., Birmingham Southern R. R., Birmingham.
 Newhouse, J. F., Manager, Ky. & Ind. Terminal Ry., Lexington.
 O'Hearne, J. E., Supt. Motive Power, Chicago & Alton R. R.
 Osmer, J. E., Supt. M. P. & M., Ann Arbor, Brighton.
 Phillips, C., M. M., New Orleans & N. E. R. R., Brighton.
 Pilcher, J. A., M. Engineer, Norfolk & Western Ry., Traymore.
 Poole, A. J., Supt. Motive Power, Seaboard Air Line Ry., Marlborough-Blenheim.
 Ramsdell, T. M., Master Car Builder, Chicago & Alton R. R., Chalfonte.
 Rink, Geo. W., M. Engineer, Central R. R. of N. J., Dennis.
 Schlafge, Wm., General Mechanical Supt., Erie R. R., Strand.
 Schmoll, G. A., Supt. Motive Power, B. & O. R. R., Marlborough-Blenheim.
 Seabrook, C. H., Supt. Machinery, Int. & Great Northern R. R., Traymore.
 Seddon, C. W., Supt. Motive Power, Duluth, Missabe & Northern Ry.
 Sheafe, J. S., Engr. Tests, Ill. Central R. R., Dennis.
 Sisco, G. E., Asst. Engr. Motive Power, Southwest System.
 Small, H. J., Gen. Supt. Motive Power, Southern Pacific Co., Marlborough-Blenheim.
 Smith, P. F., Jr., Supt. Motive Power, Penna. Lines, Brighton.
 Stockton, Jas., M. M., New Orleans Terminal R. R., Lexington.
 Terrell, C. H., Asst. Supt. Motive Power, Ches. & Ohio Ry., Haddon Hall.
 Thomas, J. J., Jr., Supt. M. P., Mobile & Ohio, Strand.
 Young, Charles D., Engr. Tests, Penna. R. R., Brighton.
 Waitt, A. M.
 Wallis, J. T., Gen. Supt. M. P., Penna., Chelsea.
 Walsh, F. J., M. M., Chesapeake & Ohio.
 Walsh, Wm. F., Traymore.
 Wyman, R. L., M. M., Lehigh & New England, Pennhurst.
 Penna. R. R., Traymore.
 Young, C. B., M. E., C. B. & Q. R. R., Traymore.

M. M. GUESTS.

Adams, T. S., M. M., Atlantic City & Shore.
 Anderson, J. A., M. M., B. & O., Chelsea.
 Anderson, J. P., Shop Supt., N. Pacific R. R., Shoreham.
 Atkinson, C. R., C. C., Penna. R. R., Russell.
 Beck, Henry J., Genl. Loco. Insp., P. & R., Speidel.
 Beyer, O. S., Jr., Rock Island Line, Chalfonte.
 Booth, H. B., Haddon Hall.
 Boring, T. J., M. P. Inspector, P. R. R., Pennhurst.
 Brennan, E. J., M. M., Buffalo, Rock Island & Pts., Arlington.
 Brown, W. R., R. H. Foreman, N. Y. & St. L. R. R., Stanton.
 Butts, H. M., M. Painter, N. Y. C. & H. R. R., 1624 Pacific Ave.
 Cadwell, Rev. Mr., Atlantic City.
 Creedon, Garret, Foreman Blacksmith.
 Critz, A. C., Eng., Danville & Western, Monticello.
 Depan, J. R., A. C. L., Lexington.
 Derick, C. T., Gen. For., P. R. R., Elberon.
 Detto, A. E., Foreman, C. R. R. of N. J., Worthington.
 Dill, E. W., Motive Power Dept., B. & O., Whittle.
 Douty, C. D., Inspector Test Dept., Penna., Iroquois.
 Edmondson, O. N., C. Drfts., P. R. R., Haddon Hall.
 Eyerly, W. S., Air Brake Foreman, B. & O. R. R., Monticello.
 Ferguson, O. G., Supt. Trans., Monongahela-Connecting, Seaside.
 Fildes, Thomas, Long Island R. R., Jackson.
 Flanagan, S. E., Supt., N. O. & N. E., Traymore.
 Flanagan, S. J., N. O. & N. E., Traymore.
 Gallagher, P. F., Gen. For. Boiler Maker, B. & O., Wittle.
 Gibson, R., Marlborough-Blenheim.
 Goodwin, Geo. S., Mech. Eng., C. R. I. & P. Ry., Chalfonte.
 Hair, John, Special Rep. Mech. Dept., B. & O., Dennis.
 Hankens, F. W., Genl. For., Cumberland Valley R. R., Monticello.
 Harris, A. J. B., Mech. Eng., Chalfonte.
 Harter, Charles, Mech. Eng., Mo. Pac., Dennis.

Herbert, W. A., Asst. Foreman, Penna. R. R.
 Hervey, D. F., Engineman Logan Div., Penna. Lines, Delanco.
 Hippey, E. S., Supervisor, Penna., Elberon.
 Hofmann, Geo. W., Asst. R. Foreman of Engs., P. R. R.
 Holzmer, J. F., Kahawha & Michigan R. R., Haddon Hall.
 Hudson, W. L., R. F. E., P. R. R., Jackson.
 Hughes, Geo. H., Schlitz.
 Jackson, Thomas J., Shop Supt., Northern Pacific, Shoreham.
 Johnson, Sidney G., Norfolk & Western, Traymore.
 Johnston, Frank D., P. O. Dept.
 Justus, I. J., Special Inspector, N. Y. C. & H. R. R., Pennhurst.
 Kane, J. R., Gen. For., B. & O., Wyoming.
 Kelleher, W. J., S. Agt., N. O. & N. E., Traymore.
 Kendrick, J. P., M. M., B. & P., Lexington.
 Lenker, C. H., Gen. For., D. & H.
 Lloyd, S. P., Drfts., P. R. R., Haddon Hall.
 Lotz, H. B., Gen. For. Loco. Shops, P. R. R., Jackson.
 McCormack, A., Gen. Foreman, B. & O., Lexington.
 McCune, F., Genl. Mgr., Monongahela-Connecting, Seaside.
 McKelvey, W. D., Retired Gen. For., Penna. R. R., Lexington.
 Mallard, J. T., M. M., Norfolk Southern, Lexington.
 Mallory, C. E., Supt. & Traffic Mgr., Kingar Ref. Line, Traymore.
 Mills, Lester W., Ch. Clerk to S. M. P., M. K. & T. R. R., Haddon Hall.
 Moler, A. L., M. M., Charlotte Harber & Northern, Alpine.
 Mullinix, J. H., Dennis.
 Murph, F. K., M. M., Big Four.
 Newberry, E. H., Asst. M. M., P. R. R., Jackson.
 Norris, W. B., Gen. Foreman, Pa. R. R., Dennis.
 Ogilvie, Jos., Traymore.
 Ord, W. E., Haddon Hall.
 Phillips, William D., Brighton.
 Philpot, J., Fore. Machinist, N. Y. Central Lines, Pennhurst.
 Pratt, I. D., Motive Power Inspector, P. R. R., 310 N. Conn. Ave.
 Rankin, John, L. & N. R. R., Chalfonte.
 Reid, J. J., M. M., D. & H., Marlborough-Blenheim.
 Riedenger, L. P., Gen. For., Penna.
 Robbins, F. S., Asst. Genl. Foreman Phg. Div., P. R. R.
 Robinson, T. M., Chief Draftsman, Hocking Valley, Traymore.
 Sandman, A. G., Ch. Draftsman, B. & O., Haddon Hall.
 Savage, H. D., Asst. M. M., A. C. & I. Ry., Traymore.
 Scheck, H. G., R. F. E., P. R. R., Jackson.
 Schmoll, G. A., S. M. P., B. & O., Marlborough-Blenheim.
 Shepp, D. B., Banker, 3 Montpelier Ave.
 Simpson, J. A., Correspondence Clerk Pres. Office, C. R. I. & P. Ry.
 Smith, J. A. B., Rear Admiral, U. S. Navy, 106 N. Vermont Ave.
 Sprowl, Lester, A. C. L., Lexington.
 Stephens, R., Foreman, N. Y., Lexington.
 Stickley, J. W., Gen. For., Norfolk Southern R. R., Lexington.
 Sweeley, Richard C., Dennis.
 Telford, A., Purchasing Agent, C. N. O. & T. & A. G. S., Marlborough-Blenheim.
 Town, Col. Thos. J., Berkshire Inn.
 Trimyer, H. L., Marlborough-Blenheim.
 Van Brunt, G. E., M. M., Penna. R. R., Elberon.
 VanSchaick, C. D., Inspector M. P. Dept., N. Y. C. & H. R., Haddon Hall.
 Vought, Harry D., Secretary, N. Y. Railroad Club, Marlborough-Blenheim.
 Wambaugh, Russell H., M. E. Special Apprentice, B. & O.
 Warthen, H. J., Jr., Wash. S. Ry., Channell.
 Weaver, C. H., Supvsr. Div. Brakes, L. S. & M. S. R., Marlborough-Blenheim.
 Weigle, John, Retired Foreman, Penna. R. R., Elwood.
 Werner, R. M., Marlborough-Blenheim.
 Winterrowd, W. H., Mech. Eng., Canadian Pacific Ry., Marlborough-Blenheim.
 Woodworth, C. B., M. P. Inspt., B. & O., Chelsea.
 Wright, O. C., Asst. Eng. Motive Power, Penna. Lines, Marlborough-Blenheim.
 Young, W. D., Asst. Trainmaster, Penna.
 Zercher, F. B., Supt. Shops, C. P. Ry., Schlitz.

SOCIETY OF RAILWAY CLUB SECRETARIES.

The Society of Railway Club secretaries will hold its annual meeting Saturday morning, at 10 A. M. in Suite 5 of the Marlborough-Blenheim. Presidents and first vice-presidents of the railway clubs, being associate members, are to participate.

At the solicitation of friends whose engagements make it impossible for them to attend a social function in the evening, the secretaries have arranged for a luncheon at the Hotel Strand at 12.30 P. M. on the same day, instead of an annual dinner as in former years.

Conventionalities.

My, but the missing ladies are numerous!

Mr. and Mrs. Albert C. Ashton and Mother Ashton are staying at the Marlborough-Blenheim.

Have you noticed the information committee badge that Lucian Brown is sporting so proudly?

Mr. and Mrs. W. H. Miner, Chicago, arrived Tuesday by way of New York, and are quartered, as usual, at Chalfonte.

J. H. Mills, master mechanic of the Canadian Pacific at Tor-



F. O. Bunnell, Engineer of Tests, Rock Island, Getting Pointers from Frank M. Gilmore, of the E. D. E. Company.

onto, Canada, arrived Tuesday afternoon, and is at Haddon Hall.

J. C. Kuhns, purchasing agent of the Illinois Central at Chicago arrived on the Special Tuesday, and is stopping at the Dennis.

S. F. Sullivan, H. C. Pierce, R. F. Kilpatrick and E. V. Shackelford, of the Ewald Iron Company, are in attendance at the conventions.

For the first time in many years George Basford is accompanied by Mrs. Basford. They are stopping at the Marlborough-Blenheim.

A. R. Ayers, general mechanical engineer of the New York



H. R. Thomson, Master Mechanic, Newburgh & South Shore.

Central Lines west of Buffalo, is the proud father of a six months' old daughter.

Mr. and Mrs. Charles D. Jenks were among the passengers who arrived Tuesday on the Pennsylvania special from Chicago. They are stopping at the Dennis.

LeGrand Parish motored over with Mrs. Parish from his summer home at Allenhurst, arriving Tuesday afternoon. They are at the Marlborough-Blenheim.

A. E. Manchester, superintendent motive power, Chicago, Milwaukee & St. Paul, and one of the old timers at the conventions, was among the arrivals on Tuesday.

E. W. Pratt, assistant superintendent motive power Chicago & Northwestern at Chicago, arrived with his wife on the Special Tuesday. They are stopping at the Marlborough-Blenheim.

W. English Wilkinson was "all in" yesterday A. M. when he learned that the American team had won the polo match. What we want to know is, was it a bet, or his nationality?

Moses when the light went out was hardly more in the dark than was the enrollment committee on Tuesday evening until O. F. Ostby got busy and illuminated it with two of his lights.

George R. Henderson, of the Baldwin Locomotive Works,

Association which holds its annual meeting on Friday evening.

G. I. Evans, of the Canadian Pacific, who is attending the convention, has gained considerably in weight since he laid down the care of the mechanical engineer's office and accepted



F. F. Gaines, Superintendent Motive Power, Central of Georgia.

the responsibilities of superintendent of the locomotive shops at Angus.

A. W. Horsey, formerly mechanical engineer and later master mechanic of the Canadian Pacific, has been on the inactive list for the past two years because of illness. He is attending the convention this year and has almost entirely recovered his health.

A. M. Waitt was seized with an acute attack of roomatism soon after his arrival on Tuesday afternoon. It was due to negligence in not having reserved a room in advance. At last report he was camping on the beach. Taking the mud cure, we suppose.

Thomas Madill, E. M. Richardson, W. B. Albright and E. L.



W. H. Lewis, Superintendent Motive Power, Norfolk & Western, Enjoying a Stroll on the Boardwalk.

made his visit to this year's convention brief, leaving last evening.

For the first time as a representative of the Baltimore & Ohio Southwestern, M. J. McCarthy, superintendent of motive power, is at the conventions. Mrs. McCarthy and son, William, are with him.

H. M. Perry (who does not think of side bearings when he hears the name of Perry?), one of the old-time master car builders, now mechanical engineer of E. S. Woods & Company, is registered at the Traymore.

Charles J. Pilliod, until recently associated with the Pilliod Bros. Company, has sold his interest in that company and is now representing the Hardy Paint and Varnish Co. He is attending the conventions as usual.

James J. McCarthy, of the Chicago-Cleveland Car Roofing Company, whose activities at these meetings in the past will be remembered, has been detained and will not be here this year.

B. P. Flory superintendent of motive power, New York Ontario & Western, is accompanied by Mrs. Flory again this year. Mr. Flory is president of the Cornell Railroad Alumni



R. D. Smith, Superintendent Motive Power, Boston & Albany, is in Fine Shape, Thank You!

Graves, of the Sherwin-Williams Company, are guests of the Marlborough-Blenheim during the conventions. Walter H. Cottingham, president of the company, sailed for Europe two weeks ago, to be absent three months.

Clement F. Street is lonely this year. Mrs. Street is not attending the conventions, and his daughter Martha, who has been a regular attendant for several years, was married on June 5 to Henry D. Hooper. Mr. and Mrs. Hooper are now spending their honeymoon in the Adirondacks.

John Purcell, assistant to the vice-president of the Atchison, Topeka & Santa Fe, is attending the convention with Maham H. Haig, mechanical engineer. Mr. Purcell has seldom been known to stray so far eastward, and his friends are wondering how it happened.

T. H. King has recently been placed in charge of general sales for the Landis Tool Company. This in recognition of his many years of specialization on grinding machinery. No one has studied more carefully the conditions existing in railway shops, and his many friends in this field will be glad to hear of his good fortune.

F. S. Anthony, superintendent machinery, Texas and Pacific, Marshall, Tex., and W. E. Maxfield, master mechanic of the same road at Big Springs, Tex., arrived Monday and are stopping at the Traymore. Mr. Anthony stated the thermometer registered 100 deg. in the shade when he left home, and on arrival here he thought he would freeze to death.



C. A. Seley in the Guise of a Supplyman.

Poor penmanship and the traditional intelligent compositor acting in combination converted the exhibit "spaces" on the pier into "shacks" in yesterday's Daily. For the harrowing details see page 1268 of that issue. Needless to say, it was a member of the Hotel Men's Association who protested against the turning of this temple of display into a "shack."

The conventions are unique for Stanley Midgly this year in two ways. This is the eleventh year he has attended them, but the first when he has been unaccompanied by Mrs. Midgly. In addition, it is the first year when he has not come prepared to play baseball. In separating him simultaneously from both his wife and his place at second fortune has dealt rather hardly with him.

When D. F. Crawford, president of the Master Mechanics' Association, registered on Tuesday afternoon, he was much pleased to find that his badge carried the number 29. It seems that when, in his younger days, he was attending the Pennsylvania Military Academy he was Cadet No. 29, and since that time he has considered it as his lucky numeral, and as often as possible has selected it as an identification mark on his property.

Only part of the fine coat of sun-burn being worn by R. C. Vilas, president of the Pyle-National Electric Headlight Company, is due to his enthusiasm for the great game of golf. After having some time ago almost abandoned gaso-

line automobiles and since then found his way around in an electric, Mr. Vilas recently bought a big locomobile and has been enjoying once more the pleasures of getting away from the boulevards. That explains the rest of the sun-burn.

Alex. Turner, president of the Bronze Metal Co., and an



E. W. Pratt of the North Western and J. D. McClintock of Wm. Sellers Co. on the Left.

ex-president of the Railway Supply Manufacturers Association motored down from New York on Tuesday in his new Winton. Mrs. Turner accompanied him, together with Mr. and Mrs. John T. Carroll and Mr. and Mrs. Robert H. Weatherly. Mr. Carroll is Assistant General Superintendent of Motive Power of the Baltimore & Ohio and Mr. Weatherly president of the Pilliod Co. All are stopping at the Marlborough-Blenheim.

There are mighty few people who attend the mechanical conventions who will not be pleased to learn of J. Will Johnson's nomination for vice-president of the Supply Association, for Mr. Johnson had been one of those who have worked mighty hard to make the conventions a success. He served on the entertainment committee from 1905 to 1911. For



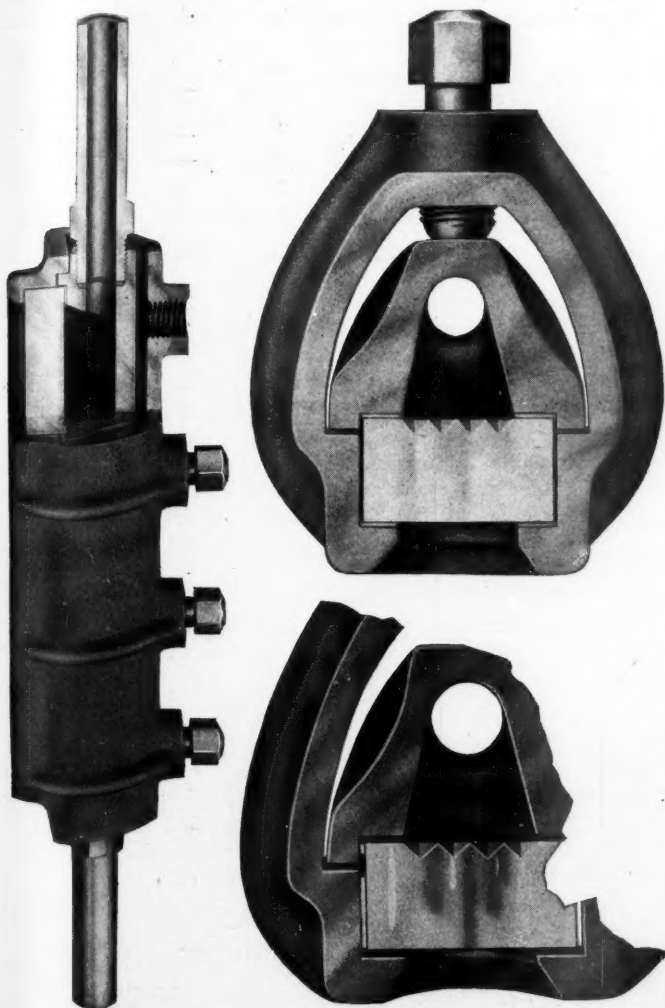
H. T. Bentley of the North Western, and His Daughter Louise.

two years he was chairman of it. Then he was transferred to the Exhibit Committee, and for two years he has been chairman of it. The man who has made a success as chairman of these two committees deserves to be honored by his fellow workers.

IMPROVED KLINGER TYPE WATER GAGE.

An improved design of Klinger type water gage is being exhibited by the Jerguson Manufacturing Company, Boston, Mass., which is claimed to overcome many of the disadvantages of the previous arrangements. This type of gage, in general, has distinct advantages, especially in connection with safety, and it is now being very generally applied to locomotives. This company has manufactured gages of this type since their introduction, and this improved design, which is styled Wiltbonco, W., is the result of a long experience in this field.

The greatest difficulty with this type of gage has been leakage and the breaking of the glasses. In this new design the glass is held by a separate brass back piece which includes the steam and water cavity. This piece is of rigid form, and is held against the glass by four set screws at the



Wiltbonco, W. Klinger Type Water Gage.

center of the back, giving a uniform pressure on the glass and eliminating most of the breakage of new glasses. Three gaskets are provided to prevent leakage, and each is in a position to do its full duty irrespective of the others. The two gaskets on the front and back of the glass are of fibre, 1-32 in. thick, and the construction allows a liberal seat on the metal. The third gasket is between a lip on the back piece and the main body, and comes at the side of the glass about one-quarter of the distance from the back. This is a 1-16 in. gasket of elastic material and formed so as to seat against the glass as well as between the lip on the back piece and the body. Its shape is shown in one of the illustrations. The introduction of this gasket is one of the principal features of advantage of this new design. Its

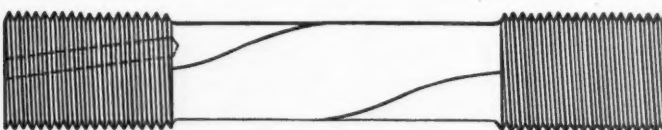
elasticity is such as to permit any unevenness in the thickness of the glass to be compensated and give an equal pressure on the fibre gasket at the top and bottom throughout the full length, while, at the same time, the elastic gasket will also be steam tight.

Another feature that has received close attention is the matter of weight. The No. 4 size weighs about 5 lbs., which is from 2½ lbs. to 4 lbs. less than previous designs of the same size. In other features the new design is the same as previous Klinger type gages in that the water shows black and steam white, and that the connections are of the proper size and form to allow it to be applied in place of the ordinary round glass without any change in the fittings.

FLEXIBLE BOLT.

The American Flexible Bolt Company, Pittsburgh, Pa., is exhibiting a flexible bolt that involves a new principle in bolt construction. It is designed to withstand bending as well as direct tensile stresses and is especially applicable to boiler staybolts, frog and switch bolts. The latter bolts can also be arranged with some degree of longitudinal resiliency. As will be noted from the illustrations these bolts are not jointed nor are they composed of several parts such as other flexible bolts, but are so made that a considerable degree of flexibility is obtained as compared with the solid bolts, although the completed bolt is of one piece.

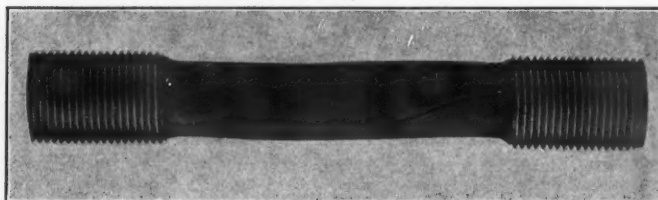
The theory on which this staybolt is based is that with a



American Flexible Staybolt Showing Location of Tell-tale Hole.

solid bolt the angular stresses act at a distance equal to that from the center or neutral axes to the outer fiber. With this construction there are two or more neutral axes, spirally arranged, and as these are very much closer to the outer fiber the breaking down stresses are greatly reduced. It has also been noted that when the bolt is vibrated the body portions move slightly on each other and this movement tends to equalize the stresses throughout the cross-section in a manner not possible with a solid cross-section. The most positive proof of the additional flexibility obtained is the difference in power required to vibrate it, as compared with a solid bolt of the same dimensions, whether under load or not.

The method of manufacture is as follows: Two or more



American Flexible Staybolt.

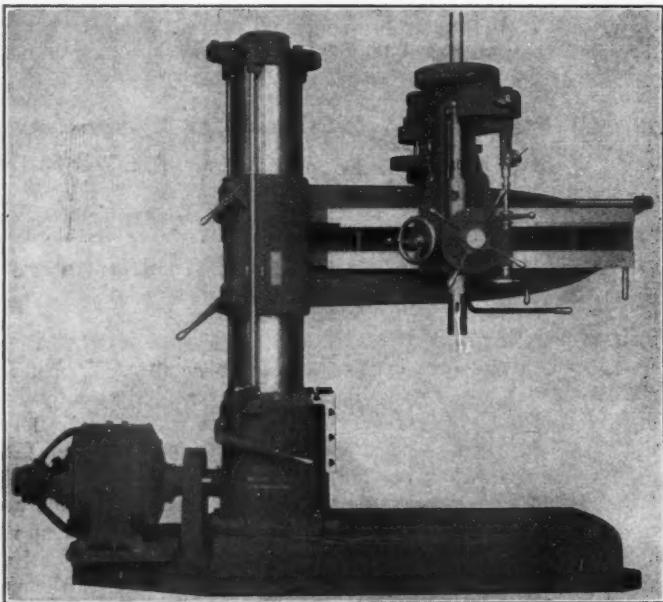
pieces of staybolt iron of the best quality are laid together, ends upset and thoroughly welded. The body between the shoulders is not welded, but is twisted approximately 180 deg. The ends, each 1½ in. long, are threaded with 12 V-threads per inch, accurately to gages as to uniformity; the tell-tale hole, as required by Federal law, is drilled ¼ in. deeper than the requirement. The design of these bolts and the tell-tale hole drilling has been approved by the Boiler Inspection Bureau of the Interstate Commerce Commission. It approximates a rope structure which would be ideal for staybolts if

possible. They are applied to the boiler in the same manner as the solid staybolt, and do not require any special preparation of the boiler. The company will also make solid staybolts similar in outline to the bolt described above, and frog and switch bolts, particularly those for heavy service.

HIGH DUTY RADIAL DRILL.

The 5 ft. radial drill shown in the illustration has been especially designed for using high speed drills. The outer column swings on a fixed inner column reaching nearly to the top, and both are greatly enlarged at the lower end and equipped with a third bearing in the middle which increases the strength and rigidity. The reinforced portion provides means for a large roller bearing to swing on and also for easy and firm clamping; the rollers are taper and of large diameter and no pressure is exerted on them in clamping. The head is provided with bearings of liberal dimensions on the face, and also a third bearing in the rear of the arm, which helps to support the head and prevent undue wear and strain on the rear shaft and the bevel gears and their bearings; it also distributes the torsional strain over the whole arm. The clamping and releasing is done by one lever placed in front of the operator.

Three speed changes are provided, giving 21 spindle speeds



Special High Duty Radial Drill.

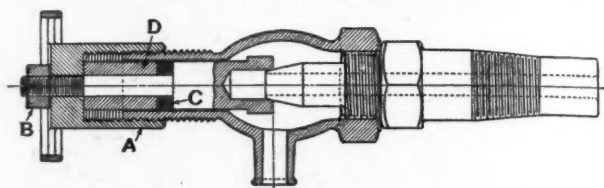
which are readily obtained while the machine is running by the operation of a single lever. The driving gear on the spindle revolves on a ball bearing. The feed is geared and has eight changes which can be varied while drilling by a conveniently located handle on the head of the machine. The new automatic stop and depth gage is an important feature. A swinging dog attached to an extension on the spindle sleeve is brought in contact with an adjustable dog on the feed bar. A graduated scale is fixed to this dog and from this the pre-determined depth of a hole may be gaged from zero. Several dogs can be put on the feed bar and the swinging dog successively brought in contact with them for different depths.

For use with constant speed motors, a speed variation device is provided which gives seven changes by means of one lever. To overcome the momentum when changing, the machine always runs at the slowest speed by means of a patented, self-releasing over-take clutch; this has nine gears made in large diameters and running in an oil bath. All high speed bearings in the machine are lined with removable

phosphor bronze bushings and all other bearings have interchangeable cast iron bushings. This machine is manufactured by the Drees Machine Tool Company, Cincinnati, Ohio.

"NEVER LEAK" GAGE COCK.

The Nathan Manufacturing Company, New York, has placed on the market a locomotive gage cock which embodies some novel features. The valve has a long conical seat which may be reground and re-cut many times before replacement is necessary, and no movable threaded parts are subjected to the action of steam or water. The movement of the spindle is effected by the threaded sleeve *A*, which moves on the externally threaded neck of the body of the gage cock. There is a slack movement between the handle and the lock nut *B* at the end of the spindle, so that in opening, the sleeve *A* moves slightly without turning the spindle, and when it strikes the nut *B* it pulls the spindle



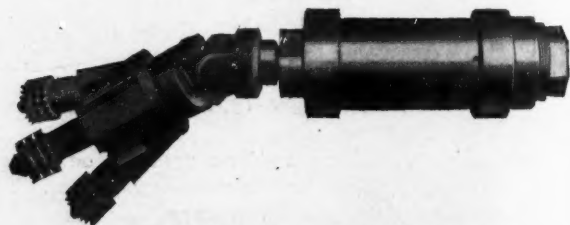
"Never Leak" Gage Cock.

off the seat without turning it. This prevents the cutting of the seat and at the same time admits of opening the valve with ease. It is also possible to grind in the valve with steam in the boiler by simply moving the sleeve *A* a slight distance back, and turning the spindle around by means of a screw driver placed in the slotted end. This is made possible by the packing *C* which is placed between the shouldered part of the spindle and the sliding cylinder *D*. It is claimed that there is always grit enough in the water to accomplish the grinding without the use of emery or other grinding material.

ARCH TUBE CLEANER.

The importance of keeping the insides of arch tubes clean is fully appreciated by all who have had charge of locomotive maintenance. On account of the size and shape of the tube, however, considerable difficulty has appeared in some bad water districts in properly performing this work. A tube cleaner that has proved successful for this purpose under very difficult conditions is being exhibited by the Liberty Manufacturing Company, Pittsburgh, Pa.

This cleaner is known as the Cyclone arch tube cleaner



Cyclone Locomotive Arch Tube Cleaner.

and is operated by air, steam or water pressure. For water, however, a special design is required. It is of the rotary type carrying a cutter head having either two or three arms, depending on the size of the tube to be cleaned. The motor of the machine consists of an outer casing in which is enclosed a removable hardened steel cylinder; eccentrically mounted in this is the shaft, which has a longitudinal slot in which a pair of semi-balanced blades reciprocate. Provision

is made for taking up the wear in the blades automatically, assuring a tight joint between their edges and the cylinder walls at all times. The air or steam is admitted to the cylinder through longitudinal ports in the walls and since the blades are mounted in the shaft, which is eccentric with the center of the cylinder, the pressure on the blades causes the shaft to rotate and thereby drive the cutter head. The air is conveyed to the machine by an oil proof hose and lubrication is provided by a sight fed lubricator attached to the air supply line. The exhaust from the cylinder requires the air to pass over the bearings both front and rear and in this way they, as well as the cylinder walls, are fully lubricated. This cleaner is operated by from 60 lbs. to 75 lbs. air pressure and consumes from 45 cu. ft. to 50 cu. ft. per minute.

When it is necessary to use steam as motive power a small stream of cold water supplied from a $\frac{3}{4}$ in. hose, and flowing through the tubes being cleaned, will prevent damage from heat.

The cutter head is attached to the motor by universal joints, and sharpened steel teeth on the end of the swinging arms will loosen and remove all scale on the interior of the tubes. Where the scale is unusually heavy a drill is provided which is rigidly mounted on the end of the revolving shaft.

IMPROVED ENGINE LATHE.

There are several attachments of especial interest on an 18 in. x 8 ft. engine lathe in the exhibit of the Lodge & Shipley Machine Tool Company, Cincinnati, Ohio. One of these is a multiple stop arrangement which provides a combination of adjustable stops for lengthwise and cross feeds, whereby all measurements after the first setting of the tool are obtained mechanically and duplicate parts having two or more diameters and a number of shoulders can be made with entire accuracy and much more rapidly than by former methods. The connected compound and plain rests is another special feature and is particularly desirable for use in connection with the multiple stop. In this construction a

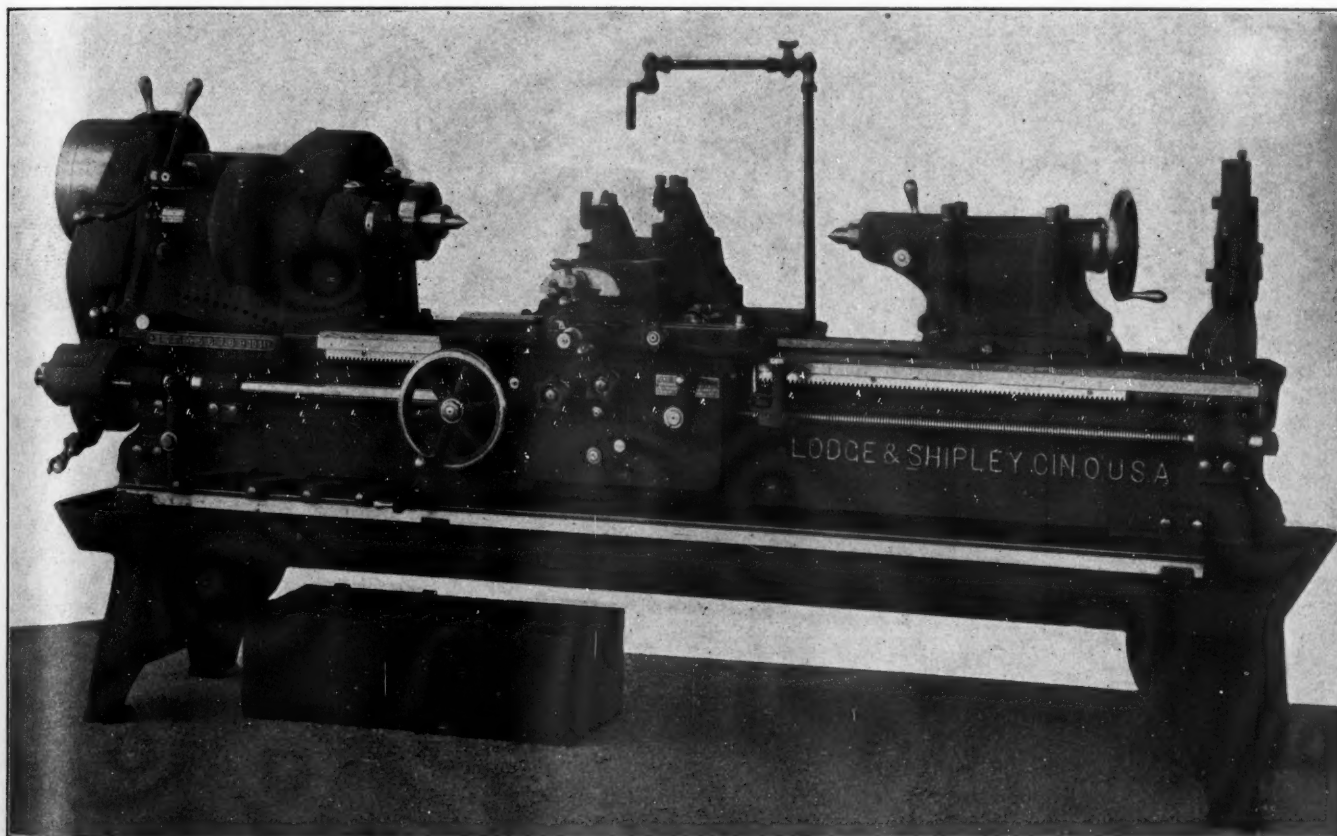
second slide carrying a rear tool post and coupled to the compound rest slide is provided. This rear extension is carefully gibbed to the carriage dovetail and is coupled to the regular slide with a tongue and groove. The rear tool block is clamped to the top of this slide by four bolts adjustable along T-slots parallel to the cross slide. This forward and backward movement of the rear tool block allows the positions of the two tools to be regulated so as to minimize the travel of the cross slide to suit the particular work on which the lathe may be engaged.

The connected compound and plain rests in conjunction with the multiple stop are particularly useful for duplicating shafts or castings having several shoulders. A regular lathe tool carried in the compound rest at the front does the turning. After the length feed is automatically tripped and while the carriage is held against the positive stop, which exactly determines the first shoulder position, the cross slide is fed toward the operator withdrawing the front tool from the cut and bringing up the rear tool to quickly square the shoulder and also to neck at that point if the piece is to be subsequently ground. The diameter stop bar is then turned to the next position, the tool stop and the length feed is re-engaged and the next cut forward is started.

Another use of the compound connected and plain rests is to take a roughing cut with the front tool and the finishing cut with the rear tool with one pass of the carriage. The front and rear tools can also be set so as to split the cut and in this way the two tools can travel at twice the speed that a single tool would and yet not exert any more strain on the work.

This machine as shown in the illustration is arranged for belt drive, but the one on exhibition is provided with a motor which drives through a belt. The headstock is arranged to give twelve mechanical speed changes which are obtained through levers located on the front, and either a constant or variable speed motor may be used.

Sixty changes of feed are possible with this tool without taking out or putting on a gear. The change gears are

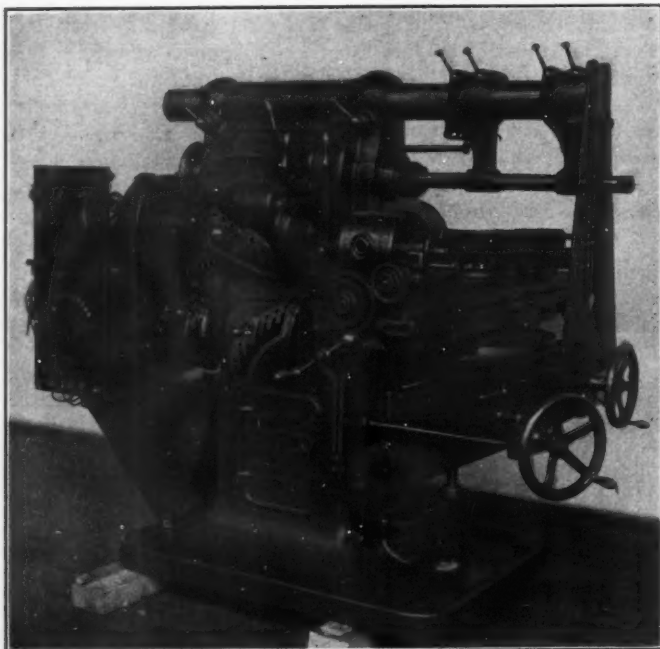


18 in. x 8 ft. Engine Lathe with Multiple Stop and Compound and Plain Rests with Two Tool Posts.

located beneath the headstock where they are out of the way and protected from dirt and chips. Any change of feed can be made while the lathe is in operation. This company is also exhibiting a 24 in. x 10 ft. engine lathe of similar construction.

GEARED SPINDLE UNIVERSAL MILLING MACHINE.

The Hendey Machine Company, Torrington, Conn., is exhibiting a universal milling machine of a size which has found considerable favor in recently equipped railroad shops. It is provided with an all-g geared motor connection, although it can be arranged for a silent chain drive if desired. A reversible motor is used. All feeds are automatic with a travel range in different directions of 30 in. and 10 in. and 19 in. There are 18 changes of spindle speeds provided, all



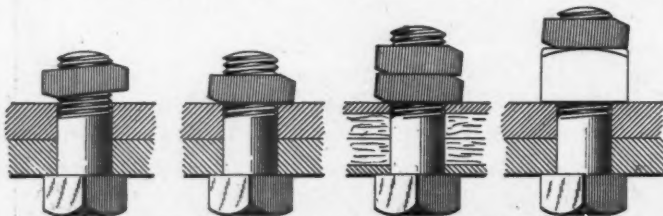
Universal Milling Machine, Motor Driven Through Spur Gearing.

through gearing and the 21 feed changes provide a travel of from $\frac{3}{16}$ in. to 21 in. per minute.

The net weight of the machine complete is approximately 5200 lbs. It is arranged for convenient operation in every particular and includes all of the latest improvements that have been developed by this company.

"DS" SAFETY NUT.

A new form of lock or safety nut is on exhibition in Space 4 in the main building. It differs distinctly from previous forms of lock nuts and can be used either with or without a standard nut. It consists simply of a thin steel



"D S" Safety Nut for Cars and Trucks.

nut with the center line of the threaded opening at an angle with face which varies by several degrees from the right angle. The threads are the same as on a standard nut in every particular and it can be run down on a bolt in the same way.

As will be seen in the illustration the higher side on both faces has been beveled off and when first seated, the nut takes a bearing close to the bolt on one side only. As it is drawn down the sharp edge of the thread at this point enters between the nut below it and the bolt and wedges itself in the thread in such shape that the lower nut is securely fastened. In addition the lock nut tends to assume the horizontal position and in this way grips all of the threads for the full circumference and securely holds itself without in any way damaging the threads on the bolt or the nut. It can be applied either side up and is released by a half turn. The illustration shows several combinations in which it can be used either alone or in connection with a standard nut. It is being exhibited by the Dieter Nut Company, New York.

WELDING SUPERHEATER FLUES.

The pneumatic welding machine shown in the illustration is being exhibited by the Draper Manufacturing Company, Port Huron, Mich., and was designed especially for the welding of superheater flues. The machine is capable, by changing the dies and mandrels, of welding or swedging flues up to 6 in. in diameter. In cases where the welding is done on the large end of the tube the machine requires a set of $5\frac{1}{2}$ in. welding dies and mandrel, and a corresponding set of swedging dies; where the weld is made on the small end, it requires a set of $4\frac{1}{2}$ in. welding dies and mandrel and a set of swedging dies. The manufacturers rec-



Pneumatic Welding Machine for Superheater Flues.

ommend that the first weld be made at the firebox end, the second at the front end and that the third weld be a repetition of the first; and welding the fourth time at the front end, each weld gives a new piece of tube at the part where it is subjected to the greatest heat. A scarfing attachment is also provided for the machine by which both the safe-end and the tube can be scarfed. The machine takes up a space about 24 in. by 36 in., which includes that required behind the machine for the mandrel brackets, so that it can be set very close to the furnace, which is an advantage when handling heavy superheater flues.